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RETIREMENT OF DR. SHEFFIELD A. NEAVE, C.M.G., O.B.E.

The retirement on 31st July of Dr. Sheffield A. Neave, Director of the Imperial Institute (formerly Bureau) of Entomology since 1942, will be deeply regretted, not only by the Executive Council and Staff of the Institute, but by entomologists throughout the world. He is known personally or by repute to a wide circle of entomologists, many of whom have reason to be grateful to him for sympathetic help and sound advice. He will take with him the best wishes of everyone on his retirement.

Dr. Neave was appointed Assistant Director of the then Bureau of Entomology in 1913 whilst serving in Africa as an Entomologist to the Entomological Research Committee (Tropical Africa). He returned to this country in March, 1914, to take up his duties and continued to fill the position until 31st July, 1942, when he succeeded Sir Guy Marshall as Director. His long experience of 33 years on the staff has been wholeheartedly devoted to building up the Institute on the principles originally laid down.

Dr. Neave's outstanding service has been the development of the Institute's Publication Office of which he has been in charge almost since its inception. The principal publication issued by this office is the *Review of Applied Entomology* which first appeared in 1913 and was taken over by Dr. Neave in 1914. It is no exaggeration to say that the "Review" is regarded to-day by economic entomologists, wherever they may be, as the one work that is absolutely indispensable to them. Apart from the many appreciations that have been received from all quarters, the steadily increasing circulation bears testimony to the high value placed on it by entomologists, not only of the British Commonwealth of Nations, but of foreign countries.

In 1939-40 Dr. Neave published his *Nomenclator Zoologicus* in four volumes. This great and painstaking work, containing the names and references of some 100,000 genera of insects, is a standard reference work of the greatest importance to every systematic worker.

The "Review" and the "Nomenclator" represent a major contribution to the advancement of entomological knowledge and they will be a constant reminder for many years to come of Dr. Neave's great service to entomology.

For the past four years Dr. Neave, as Director, has supervised the *Insecta* part of the *Zoological Record* and edited the *Bulletin of Entomological Research* in addition to all his other duties. This period of the later war years and first post-war years has been one of considerable difficulty and the successful manner in which it has been negotiated must be attributed to his ability and wise guidance.

Dr. Neave is being succeeded by Dr. W. J. Hall, M.C., D.Sc., who joined the staff of the Institute in 1943 after 23 years' service in Egypt and Southern Rhodesia, and was appointed Assistant Director in 1944. The latter's place as Assistant Director is being filled by Dr. T. H. C. Taylor, D.Sc., who joined the staff in November, 1944, after 19 years' service in Fiji and Uganda.

J. G. ROBERTSON, Lt.-Col.
Chairman of the Executive Council
of the Imperial Agricultural Bureaux.

July, 1946.

STEINBAUER (G. P.) & STEINMETZ (F. H.). **Eradication of certain Maine Weeds, an important Step in Control of Potato Diseases spread by Aphids.**—*Misc. Publ. Maine agric. Exp. Sta.* no. 602, 22 pp., 10 figs., 14 refs. Orono, Me., 1945.

Aphis rhamni, Boy. (*abbreviata*, Patch), *Myzus persicae*, Sulz., *Macrosiphum solani*, Kalt. (*Myzus pseudosolani*, Theo.), and *Macrosiphum solanifolii*, Ashm., transmit the leaf-roll virus [*Coriun solani* of Holmes] from diseased to healthy potatoes in Maine [cf. R.A.E., A 33 2]. The first overwinters on dwarf buckthorn (*Rhamnus alnifolia*), the second on wild plum (*Prunus nigra*) and certain of them on wild rose; and some weeds, particularly wild "mustard" (*Brassica campestris*), wild radish (*Raphanus raphanistrum*) and hemp nettle (*Galeopsis tetrahit*) are very favourable food-plants on which the Aphids multiply during late spring and summer [cf. loc. cit.]. Since the Aphids may migrate for considerable distances, it is desirable to keep the populations as low as possible to produce crops free from virus. This may be done by the use of insecticides and by destroying the alternative food-plants, and this paper contains illustrated instructions on the identification of weeds that favour the development of Aphids and on methods of eradicating them.

Wild plum is not effectively destroyed by cutting, as this encourages the development of suckers, but was killed by injecting a saturated solution of copper sulphate or solutions of 2 lb. ammonium thiocyanate, 2 lb. ammonium sulphamate or 4 lb. sodium arsenite per U.S. gal. water into holes $\frac{3}{4}$ in. in diameter drilled on a downward slope, 3 ins. deep and 3 ins. apart, round the circumference of the tree or into cuts made with an axe, or by spraying the foliage thoroughly with a solution of 1 lb. ammonium sulphamate per U.S. gal. water in late August or early September. These treatments may not injure the embryos within the fruits, and any seedlings that appear under trees or thickets that have been killed should be eliminated by spraying with ammonium-sulphamate solution or by covering the ground with crude borax powder at the rate of $\frac{1}{2}$ lb. per sq. yard. The latter treatment may prevent plant growth for some time. Wild plum may also be killed by piling straw in the thickets and burning it or by pulling out the trees, but suckers or seedlings may have to be dealt with later. Dwarf buckthorn and wild roses growing near potato fields should be sprayed with 1 lb. ammonium sulphamate per U.S. gal. water late in the growing season.

Cultivation, hoeing and hand-pulling seem to be the only practical means of eliminating *B. campestris*, *R. raphanistrum* and *G. tetrahit* from potato fields, but the number of weed seeds in the soil at planting time can be greatly reduced by previous eradication of the weeds along headlands, field roads and fences, by preventing an accumulation of weed seed in the soil during the growing of grain in the crop rotation, and by planting weed-free crop seed. A few scattered weeds in grain fields may be pulled by hand, but if many are present, sprays of dilute sulphuric acid, copper salts or compounds of dinitro-ortho-cresol, or a specially prepared cyanamide dust will kill broad-leaved weeds and cause little or no permanent damage to the cereal crop. Sulphuric acid has not been recommended or used in Maine because it corrodes the metal parts of the sprayers. The sulphate is the only copper salt extensively used in the State, although the chloride and nitrate are more toxic to weeds. It should be applied at the rate of about 40 lb. in 100 U.S. gals. water per acre, and fresh cyanamide dust at about 100 lb. per acre. Both are most effective during warm humid weather and should be in contact with the plants for 24-48 hours or longer before rain. Compounds of dinitro-o-cresol are much less dependent on weather conditions. In Maine, a super-saturated solution of the sodium salt (Sinox) is used in a 1 per cent. solution with the addition of 1 lb. ammonium sulphate or sodium bisulphate per 100 U.S. gals. to increase its effectiveness, the spray being applied at the rate of 100 U.S. gals. per acre.

In a test of this treatment in 1944, fields of oats or barley containing weeds (including the three of importance as Aphid food-plants) and interplanted clover were sprayed with a 1 per cent. solution containing 1-3 lb. ammonium sulphate per 100 U.S. gals. at the rate of about 100 U.S. gals. per acre. The spray increased the yield of grain on one farm, in spite of the unfavourable season, but did not affect it significantly on four others. It reduced the amount of weed seed produced by 60-97 per cent., the reduction being greatest when it was applied while the weeds were small. It injured the clover, but preliminary data indicate that satisfactory stands may be obtained by broadcasting the clover seed after the treatment. Weeds on waste ground can be killed with the same sprays, preferably applied at higher concentrations to ensure complete kill of mature as well as seedling plants. In crimson clover, on which herbicides cannot be used, frequent cutting of the weeds to prevent seed formation seems to be the only control measure available at present.

BUCKELL (E. R.). **The Grasshopper Outbreak of 1944 in British Columbia.**—*Canad. Ent.* 77 no. 6 pp. 115-116. Guelph, Ont., 1945.

Grasshoppers in British Columbia normally occur in fairly regular cycles of abundance that reach a peak about every seven years, with one or two species predominating, but are not concurrent throughout the Province and are frequently not great enough to attract attention. The outbreak that occurred in 1943-44, however, was far more severe and widespread than usual, and *Melanoplus mexicanus*, Sauss., was the only species concerned in it. Grasshoppers have become increasingly numerous during the past 20 years in range land in the dry interior of the Province, but *Camnula pellucida*, Scud., the chief species involved, has been kept under excellent control by a diesel-oil spray applied to the egg-beds during the hatching period followed by the use of poisoned bait against the adults. *C. pellucida* was very scarce in 1943-44, as it had been almost eliminated for several years by a fungous disease, and the measures used against it were ineffective against *M. mexicanus*, as the latter does not have defined egg-beds, hatches and is active over a long period, and does not take poisoned bait readily. It penetrated into the highest range areas, where it had not hitherto been recorded in numbers. It was not attacked by the fungus that destroyed *C. pellucida*, but Sarcophagid parasites began to increase rapidly in 1944 in districts in which it had been plentiful for two years or more and killed many adults before the females had started to oviposit. *Sarcophaga kellyi*, Ald., which had previously been scarce, was one of the important species.

SEVERIN (H. H. P.), HORN (F. D.) & FRAZIER (N. W.). **Certain Symptoms resembling those of Curly Top or Aster Yellows, induced by Saliva of *Xerophloea vanduzeei*.**—*Hilgardia* 16 no. 7 pp. 337-350, 8 pls. (1 col.), 1 fig., 41 refs. Berkeley, Calif., 1945.

Xerophloea vanduzeei, Lawson, is a Jassid that is apparently confined to California, where it is common on *Atriplex semibaccata* in the Imperial, Salinas and San Joaquin Valleys; it has also been found on other weeds and on lucerne, grape-vines and vetch. In the course of investigations in 1938 on possible vectors of the aster yellows [*Chlorogenus callistephi* var. *vulgaris* of Holmes], it produced symptoms in asters (*Callistephus chinensis*) closely resembling those due to this virus, even when it had been reared entirely on healthy asters. Similarly, it produced some symptoms on sugar-beet resembling those of curly-top [*C. eutetticola* of Holmes] without having previously fed on infected plants. It has not been observed on aster or sugar-beet under natural conditions, and the injury is not therefore likely to be of economic importance.

but it appears that definite identification of the two viruses is not possible from the symptoms alone. The literature on disease-like conditions caused in plants by the feeding of various Hemiptera is reviewed, and the results are given of an investigation of the injury caused by *X. vanduzeei*.

The following is based largely on the author's summary. Eggs were deposited singly in the petiole, mid-rib and veins of sugar-beet leaves under greenhouse conditions. The nymphs moulted five times during their development, with the exception of one, which moulted six times. Each instar can be determined accurately by measurements of the head across the eyes; the duration of each is shown for each sex in a table. The males differ in colour from the females, of which there are three colour forms. On sugar-beets, the feeding of *X. vanduzeei* induces cleared veinlets, previously considered a reliable symptom of curly-top. On asters, it induces cleared venation with yellow veinbanding, stunting of the plants, development of axillary shoots from the bud in the axil of the leaves, and virescence of the flowers, all of which are symptoms of aster yellows. The most striking effect produced by the feeding of the Jassids is breaking in the colour of the petals. Inoculation of the leaves, mid-rib and petioles of healthy beet seedlings and aster with sap from affected plants by means of carborundum or a needle gave negative results, but beets inoculated by means of a needle in the crown between the bases of the petioles developed the characteristic yellowing and necrosis on the outer leaves. No symptoms appeared on the younger leaves. Crushing the salivary glands of the nymphs into punctures between the bases of two petioles induced yellowing and necrosis in one or more of the outer leaves of beet. Known vectors of curly-top and aster yellows failed to transmit the causative agent from plants showing symptoms of injury caused by *X. vanduzeei* to corresponding healthy plants. Experiments showed that the active principle is systemic in both sugar-beets and asters, and it is presumed to be due to a toxic salivary secretion. The time required for the development of symptoms on aster was less for nymphs of each instar than for the adults, and longest for overwintered females of two colour forms.

LAL (K. B.) & SINGH (R. N.). **Control of Woolly Aphis by *Coccinella septempunctata* Linn.**—*Indian Fmg.* 6 no. 1 pp. 24-25. Delhi, 1945.

In the Kumaun hills (United Provinces), *Eriosoma lanigerum*, Hsm., is active on apple throughout the year except in the very cold period from mid-December to mid-February. It multiplies rapidly from March to mid-June and from mid-October to December, and slowly in June-October, when it appears to be adversely affected by the moist heat. It becomes very abundant in some areas during March-June, but is controlled in others by *Coccinella septempunctata*, L., which preys on all stages [cf. R.A.E., A 32 392]. This Coccinellid is fairly common in other parts of the United Provinces, the Punjab and southern India, where it usually preys on Aphids on cereals, mustard and cotton; *E. lanigerum* is probably its favoured prey in the Kumaun hills, but it also attacks Aphids infesting two wild grasses, *Andropogon pertusus* and *A. assimilis*. It was observed on apple until the beginning of winter, when it migrated to these grasses; it bred on them in November and the emerging adults hibernated during the rest of the cold season and migrated to apple trees in early spring when the colonies of *E. lanigerum* were appearing.

Although *C. septempunctata* gives almost complete control of the Aphid during the summer in some orchards it is scarce in others that are climatically similar but do not contain the two grasses, and it is therefore desirable to foster it by introducing the grasses into such areas. Laboratory and field observations indicate that it has only one generation in the year in the Kumaun hills and can survive without food for about a month, which may facilitate its transport from place to place.

GOBIND RAM. **A Study on the Life-cycle of *Bruchus analis* Fab., the common Pulse Beetle.**—*Curr. Sci.* **14** pp. 273–274. Bangalore, 1945.

Under laboratory conditions in Sind at a constant temperature of 92°F., the egg and pupal stages of *Bruchus analis*, F., were completed in 5–6 and 7–10 days, respectively, and the larval stage averaged 11½ days in each of three species of beans (*Phaseolus*) and 17½ days in chick peas (*Cicer arietinum*). Males and females, fed on powdered pulses, survived for averages of 9 and 9½ days. They paired on the day of emergence, and the females began to oviposit next day and continued to do so for about 9 days, laying totals of 69–104 eggs, with an average of 84.

CHABOUSSOU (F.) & LAFAUR (J.). **La lutte contre l'hoplocampe des prunes (*Hoplocampa flava* L.) en Agenais.**—*C.R. Acad. Agric. Fr.* **31** no. 2 pp. 60–64, 8 refs. Paris, 1945.

Hoplocampa flava, L., is a serious pest of plums in the region of Toulouse in years in which the trees are in flower when the adults emerge in numbers. Thus, 75 per cent. of the fruits were infested in 1943 when the peak of flowering of the plum trees occurred on 27th March and was followed by mass emergence of the sawflies two days later, but infestation was slight in 1944 when March was colder, mass emergence was on 1st April and the peak of flowering occurred six days later. Infestation in the latter year was more severe on the southern slopes of hills than in the plain.

In experiments in 1944, sprays were applied in three orchards as soon as all the petals had fallen. At this time, the eggs are about to hatch and they protrude from the slits in which they were deposited [*cf. R.A.E.*, A **21** 560]. The percentages of fruits infested were 20 on unsprayed trees, 0.75 on trees treated with a derris spray containing 0.00375 per cent. rotenone, 0.425 per cent. terpene alcohols and 0.3 per cent. refined petroleum oil, and 2.3 on those treated with a synthetic organic preparation containing 12 per cent. benzene hexachloride diluted to a concentration of 1 : 50, and both these sprays increased the weight of crop from the trees by more than 450 per cent. A quassia spray reduced the infestation in one orchard to 0.93 per cent., but increased the yield in a second by only 54 per cent. It was prepared by soaking 2 lb. powder of *Quassia amara* in 10 gals. 2½ per cent. soap solution, but the period of soaking was 72 hours for the spray used in the first orchard and only 24 hours for that used in the second. A lead-arsenate spray (about 0.1 per cent. As) and one containing nicotine sulphate (0.14 per cent. nicotine) gave poor results with a single application, but two applications of lead arsenate spray, the second 8 days after the first, increased the weight of crop by 300 per cent.

ROBIN (F.) & DUPREZ (R.). **La lutte contre les frelons et les guêpes dans les vergers.**—*C.R. Acad. Agric. Fr.* **31** no. 2 pp. 104–107. Paris, 1945.

Wasps (*Vespa germanica*, L., and *V. vulgaris*, F.) and hornets (*V. crabro*, L.) cause much damage to ripe fruit in orchards in central France, particularly when the weather is hot and dry. The wasps make their nests in the soil and fly to orchards within a distance of about 550 yards, and the hornets nest in trees and fly about three times as far. Individual colonies can be destroyed by inserting a little calcium cyanide into the entrance holes of the nests, but as it is difficult or impossible to treat all the nests in an area, some method of protecting the fruits themselves is required. Various sprays were tested for this purpose in August 1944, and one containing a small quantity of DDT applied to peaches, pears and apples afforded almost complete protection for about 15 days against hornets and for about 19–20 days against wasps, despite heavy rain soon after its application. The fruits were slightly marked with

whitish stains, which were of no importance in the case of pears and apples but somewhat spoiled the appearance of the peaches. No taste could be detected 8 days after the treatment, even if the fruits were eaten with the skin.

WILSON (F.). *The Control of Insect Pests in Victorian Bulk Wheat Depots.*—*J. Coun. sci. industr. Res. Aust.* 18 no. 2 pp. 103–109, 3 refs. Melbourne, 1945.

The temperature and moisture content of wheat stored in bulk in Victoria in recent years have been too low to favour infestation by insects, but it occurs in the outer layer of the mound [cf. *R.A.E.*, A 34 121–122, etc.], which is subject to the influence of seasonal climatic conditions. Their effects are modified by the structure of the depot so that the temperature is highest at the crest of the mound and moisture content highest at the bottom of the slope. Infestation by pests that require a relatively high temperature, notably *Rhizopertha dominica*, F., which is the most important, is, however, mainly the result of prior infestation by other insects, which raises the temperature of the wheat. Initial infestation is usually by *Tribolium castaneum*, Hbst., which develops in numbers at the warmer sites, particularly at the top of the mound; *Oryzaephilus surinamensis*, L., is often present at the same time, and *Laemophloeus minutus*, Ol., appears shortly afterwards, but when the increase in temperature caused by the infestation reaches its maximum, *R. dominica* and *Latheticus oryzae*, Waterh., together represent 99 per cent. of the total insect population. *Latheticus* may outnumber *Rhizopertha*, but is considerably less injurious; its increase is probably favoured by the large quantities of "flour" produced by *Tribolium*. *Calandra granaria*, L., and the small strain of *C. oryzae*, L. [34 21] may occur in small numbers in the relatively cool wheat near the surface of the crest of the mound if climatic conditions or infestation by other insects permit an increase in its moisture content, but tend to be more numerous in the moister wheat at the bottom of the slope. Although infestation by *Rhizopertha* first appears in the warmest part of the mound it gradually heats the adjacent wheat, and so is likely to spread eventually over the whole surface. New infestations commonly originate in wheat surrounding the poles supporting the roof, since migrating insects alight on them and pass down them into the wheat below.

Inert mineral dusts used in quantity against insects in wheat stored in bulk increase the angle of repose of the grain and reduce the rate at which it can be handled [33 319] and also render the atmosphere of the depot and of the mill abnormally dusty and detract from the appearance of the grain. A method was therefore adopted in which the application of the dusts was confined to the surface of the wheat, in order to reduce the rate at which new infestations arise, and any infestations that were able to develop were controlled by local surface fumigation [33 318]. The dust employed for this purpose is finely-divided magnesite or dolomite, and it should be applied particularly thickly to the wheat surrounding the roof-poles; the value of raking it into the wheat [33 318] appeared to be doubtful in large-scale trials. Carbon bisulphide was the most effective fumigant tested; at a rate of 16 fl. oz. per sq. yd. of wheat surface it gives almost complete control of the adults and immature stages of *Rhizopertha*, and has proved uniformly satisfactory on a commercial scale. Its value against the less important pests has not been investigated, but *Laemophloeus* is known to be highly resistant. A proprietary mixture of ethylene dichloride and carbon tetrachloride (3 : 1 by volume) and a 3 : 1 mixture of ethylene dichloride and trichlorethylene, both of which are less explosive and less toxic to man than carbon bisulphide, gave almost complete control of larvae and adults of *Rhizopertha* at a dosage of 45 fl. oz. per sq. yd. The first mixture was equally effective against *Latheticus* and was exclusively used in Victoria, but sometimes gave erratic results so that refumigation was necessary. The effect of the second

mixture on the other insects is not known, but in one test it gave poor results against some. Ethyl formate (16 fl. oz. per sq. yd.) gave almost complete kill of adults and immature stages of *Rhizopertha* and 90 per cent. kill of adults of *Latheticus*, but larvae of the latter were more resistant. It is somewhat less toxic to man than carbon bisulphide, but is almost as explosive.

Although the use of dust barriers combined with localised fumigation was not adopted until large quantities of wheat had been placed in storage, it has prevented the development of any very extensive infestations. To ensure satisfactory results, the dust should be applied as soon as the wheat is placed in store, the whole surface should be examined monthly, and any infestations noted should be fumigated promptly in order to keep down the number of dispersing insects and prevent the development of high temperatures that would be slow in falling and would thus favour infestation over a considerable period. Under these conditions, and provided that the wheat is reasonably free from infestation and of low moisture content when placed in store, losses are likely to be only slight over a period of several years.

GREAVES (T.). Experiments on the Control of Cabbage Pests in North Queensland.

—*J. Coun. sci. industr. Res. Aust.* **18** no. 2 pp. 110–120, 6 refs. Melbourne, 1945.

The following is based on the author's summary. The results are given of two field experiments with dusts for the control of cabbage pests, carried out in the Burdekin area, North Queensland. On an early crop attacked by *Hellula undalis*, F., *Heliothis armigera*, Hb., *Prodenia litura*, F., and *Crocidolomia binotalis*, Zell., and not by Aphids, dusts containing DDT (1 and 5 per cent.), lead arsenate (10 and 20 per cent.), calcium arsenate (10 and 20 per cent.) and cryolite (40 per cent.), all gave very satisfactory control after four applications made at ten-day intervals. Magnesite, derris dusts containing 0.5 per cent. rotenone, and magnesite with the addition of 6 per cent. nicotine sulphate [*cf. R.A.E., A* **33** 322] were significantly inferior. On a later crop, the DDT dusts (1 and 5 per cent.) were significantly better than any other treatment against *Plutella maculipennis*, Curt., and *Myzus persicae*, Sulz., which were the dominant insects present, and magnesite with nicotine sulphate was significantly better against the Aphid than four timbo dusts containing 0.5 per cent. rotenone. These, in turn, were superior to cryolite (40 per cent.); all other treatments were inferior. The crop was so heavily infested by the Aphids that dusts that had no effect on them were removed from the plants by their movements and so did not affect the larvae of *P. maculipennis*. The derris and timbo dusts containing 0.5 per cent. rotenone and a timbo dust containing 1 per cent. rotenone, which was applied after the comparison of the other dusts, were ineffective against *H. armigera* and *Prodenia litura*.

The combined results of the two experiments indicated that when used to dilute lead and calcium arsenate, the order of effectiveness of the diluents was "pyrophyllite," kaolin, and hydrated lime. The Australian "pyrophyllite", deposits of which are found in New South Wales and which contains a mixture of hydrated potassium ammonium silicate and siliceous pyrophyllite, is a very easy dust to apply and flows very readily. The local Burdekin lime is a cheap useful diluent for lead and calcium arsenate when superior diluents are in short supply.

SPAWN (G. B.). Tillage Methods in Grasshopper Control.—*Bull. S. Dak. agric. exp. Sta.* no. 379, 16 pp., 6 figs., 13 refs. Brookings, S. Dak., 1945.

In South Dakota, certain types of autumn or spring tillage have been found to reduce the numbers of grasshoppers on a given area of ground, and investigations were therefore begun in the autumn of 1939 to determine the comparative

value of various tillage methods in preventing oviposition or destroying the eggs. Other work on this method of control and recommendations for it are reviewed [cf. R.A.E., A 21 649; 27 655; 30 365], and facts of importance in planning for grasshopper control are discussed.

The grasshoppers that do most of the damage to crops in South Dakota are *Melanoplus bivittatus*, Say, *M. differentialis*, Thos., and *M. mexicanus*, Sauss. *M. bivittatus*, which hatches early [cf. 29 603] and may produce adults by 10th July, sometimes does considerable damage to small grain and later to maize and lucerne. *M. differentialis* usually hatches 2-3 weeks later and may damage late-maturing varieties of small grain and injure maize and lucerne seriously. *M. mexicanus*, which hatches early and may do serious damage to small grain and lucerne, is usually less injurious to maize than are the other two, but sometimes greatly reduces the yield by devouring the silks and stopping pollination. All three species cause damage to flax. *M. femur-rubrum*, Deg., which hatches later, is less injurious, but may do local damage to lucerne seed crops and to small grain and grass planted in autumn. All these grasshoppers overwinter in the egg stage, oviposition taking place from late July until the first hard frosts. *M. bivittatus* and *M. differentialis* prefer to oviposit in grass areas or not too heavy sod, where the soil is fairly well packed, and the eggs are always laid near the preferred food-plants on waste ground, the edges of stubble fields, round the base of maize or cane plants or in lucerne fields. The eggs of *M. mexicanus* are deposited in fields of small grain before they are harvested and occur throughout the fields rather than mainly near the edges, though they are also laid in waste ground. All three species avoid soil that is freshly tilled. *M. femur-rubrum* oviposits later than the others and is more likely to be found in pasture areas. It deposits its eggs in waste grassland and, in outbreak years, is abundant in stubble fields, where self-sown grain provides food late in the season. Areas such as those mentioned should be examined at fairly frequent intervals in late September to determine the degree of egg infestation. As the eggs are usually within two inches of the surface, the soil should be scraped away to this depth over an area of 1 sq. ft. and the egg-pods counted as they are found, or the soil should be removed and sieved. A chart is given by which the damage to be expected can be estimated from the numbers of egg-pods obtained in cultivated and uncultivated ground.

The experiments showed that the method of tillage most effective against the eggs is ploughing to a depth of 5-6 ins. and this is recommended where there is no danger of soil erosion. It turns the eggpods over and buries them so deeply that hoppers that hatch may be unable to reach the surface and the eggs are subjected to a lower temperature, which prolongs the egg stage and thus gives additional opportunity for attack by moulds, parasites and predators. Disking disturbs the surface layer of soil and exposes broken and whole egg-pods to desiccation by sun and wind and to parasites and predators; the mite, *Eutrombidium trigonum*, Hermann, was frequently seen feeding on eggs brought to the surface by tillage in spring. Spike and spring-tooth harrows disturb the soil and egg-pods under certain conditions, and sub-surface cultivation, if carried out so that the soil is broken up, destroys many eggs. Listing gave only fair control in heavy soils in autumn and none in spring. All methods do a certain amount of mechanical injury to the pods and eggs. It is emphasised that thoroughness is essential and that co-operative control is desirable, though individual action has some value, since early crops are injured most by hoppers produced in the immediate vicinity. Autumn tillage is most effective, but early spring tillage can be used to advantage. Tillage should not be expected to give complete control, and poisoned baits should be used in areas that are difficult to till. These are most effective when the young hoppers are still in their hatching grounds.

Tillage before the grasshoppers oviposit may be used to concentrate the eggs, since these are not readily deposited in loose soil and the destruction of

weeds removes the food of the adults. For this purpose, stubble fields should be tilled soon after harvest, except for strips about 15–20 ft. wide and 100 yards apart in the field and a border of 15–20 ft. round it, which should be left to attract egg-laying and tilled in late autumn.

Suggestions are made for immune, resistant or early-maturing crops to be planted when the State egg survey in autumn indicates an outbreak the following year, and it is pointed out that sowing small grain into the previous year's stubble may result in the destruction of the entire crop, and that lucerne of several years' standing may be harrowed in autumn without serious injury to the crowns of the plants. The experimental methods used are discussed in an appendix.

BERRY (F. H.). Effect of Site and the Locust Borer on Plantations of Black Locust in the Duke Forest.—*J. For.* 43 no. 10 pp. 751–754, 2 refs. Washington, D.C., 1945.

Black locust [*Robinia pseudacacia*] was planted alone or mixed with pines in 62 plantations in Duke Forest, North Carolina, between 1930 and 1938. By 1944, 23 per cent. of the plantations had failed entirely, 50 per cent. were decadent, and the remainder were in only fair condition. Many of the plantations were on eroded areas, and their condition is attributed primarily to the pooriness of the sites and to damage by *Cyllene robiniae*, Forst. Only 10 per cent. of the trees that were less than 0.5 inch in diameter at breast height were attacked by this Cerambycid, as the smooth bark did not provide suitable sites for oviposition. Trees 1–5 inches in diameter were most susceptible, and almost all those with diameters of 2.5–5 inches were infested. On small trees, the damage occurred at the base of the trunk, where the diameter was greatest and the bark roughest. Injury to trees exceeding 5 inches in diameter was light, and the wounds had completely healed. Slow-growing trees on poor sites were heavily infested and were seldom able to recover, whereas the more vigorous of the trees on the better sites were only slightly damaged and outgrew the injury. Attack was heaviest in plantations near old locust trees that served as breeding sites, and the relative lightness of the damage observed on 34,000 trees planted on poor soil in the eastern part of Duke Forest may have been due to the absence of old, infested trees. There was no evident difference in infestation between trees interplanted with pine and trees in pure stands, between the shipmast variety of black locust and the ordinary one, or between trees on poor soil and the sprouts that grew up when they were coppiced.

FRIEND (R. B.). Connecticut State Entomologist, Forty-third Report, 1943.—*Bull. Conn. agric. Exp. Sta.* no. 481, pp. 235–324, 19 figs., refs. New Haven, Conn., 1944.

A brief survey of work on insect pests and records of their abundance in Connecticut during the year ending 31st October 1943 are given by R. B. Friend (pp. 235–242). M. P. Zappe and L. A. Devaux (pp. 246–249) review the results of inspections for the presence of *Popillia japonica*, Newm., and the gypsy moth [*Lymantria dispar*, L.] in a report on the enforcement of quarantines. In a survey of work on the control of *L. dispar*, J. T. Ashworth and Friend (pp. 253–256) state that defoliation, which in 1942 was the lowest recorded since 1924, declined still further in 1943, and it is thought that many eggs not protected by snow cover were destroyed by cold weather in the winter of 1942–43. Larvae hatched from 8 of 10 egg-masses collected from situations within a foot of the ground in northern Connecticut and from only 14 of 60 collected from higher situations. The temperature was below 0°F. on several occasions during the winter, and fell to about –24°F. in February. After

the winter of 1939-40, when low temperatures were less frequent and did not fall below -6°F. , larvae hatched from all egg-masses collected and about 80 per cent. of the eggs survived, irrespective of their height above the ground.

In a brief review of work on biological control, P. Garman (p. 263) states that large numbers of eggs of the oriental fruit moth [*Cydia molesta*, Busck] were obtained in the laboratory on green cellophane, thus eliminating the necessity of growing the privet previously used to provide leaves on which the females could oviposit. Parasitism of *C. molesta* by *Macrocentrus ancylivorus*, Rohw., was in most cases high in peach orchards in which continued liberations of the parasite had been made; in most cases it survived the cold winter of 1942-43. Infestation of apple by Comstock's mealybug [*Pseudococcus comstocki*, Kuw.] showed a general decline throughout the State. Two consignments of the parasite, *Pseudaphycus* sp., were received during the summer, and it was released in three orchards in which the mealybug was abundant.

J. C. Schread (pp. 264-267) gives an account of work on the biological control of *Popillia japonica*. Dust containing the spores of *Bacillus popilliae*, which causes milky disease, were distributed in 24 areas during the year. The establishment and spread of the disease in experimental plots was more satisfactory than in previous years [cf. *R.A.E.*, A 32 91], especially in those that had been established for some time. The percentages of larvae infected in two areas fell from 43.3 and 18.5 in June to 11.6 and 14.6 in the autumn, and this is attributed to a decrease in soil temperatures, since the bacteria become inactive at 60°F. The disease was found in one area in which spores had not been distributed, 71.4, 50 and 15.2 per cent. of the larvae being infected at three places in it. Soil temperatures in the absence of snow cover probably fell below the point lethal to larvae of *P. japonica* [cf. 23 320] in widely separated parts of Connecticut during the cold winter of 1942-43; of the larvae collected in some areas in spring, 25-42 per cent. were dead. Adults of *Tiphia vernalis*, Rohw., were looked for at 25 of the sites at which this parasite had been liberated 2-8 years previously. They were found at only five of the sites, but were numerous at two of them. The relative abundance of larvae of *P. japonica* and cocoons of *T. vernalis* was determined in early spring at 18 per cent. of all the liberation sites. Cocoons were found at all the sites colonised in 1936 and 1937, at 33 per cent. of those colonised in 1938 and at 14 per cent. of those colonised in 1939. The ratio of larvae to cocoons indicated 45.8 per cent. parasitism in the sites colonised in 1936 and 9.3 per cent. in those colonised in 1938 and the average numbers of larvae per sq. ft. in these sites were 2.3 and 8.1. *T. popillivora*, Rohw., was found in August and early September to be numerous at nine of 22 sites at which releases were made in 1937 and 1938; large numbers of adults were collected at one of them and released at five other sites in central Connecticut.

In reporting the results of laboratory investigations on *Bacillus popilliae*, R. L. Beard (pp. 267-268) states that the incidence of disease resulting from injection of spores into the body cavity of larvae of *P. japonica* follows a characteristic dosage response curve, and that relatively high concentrations of spores are required to cause much disease. Infection very seldom results from injection of spores into the fore-gut. A characteristic dosage response was also noted among larvae placed in soil containing spores; a concentration of over 3,000,000 spores per gm. dry soil was required to produce 60-75 per cent. infection. This indicates that the disease cannot be widely spread as a direct result of inoculation of the soil with spores; the inoculations should be concentrated in spots in which the larvae are abundant and from which it can be spread naturally by those that become infected.

J. P. Johnson and Garman (pp. 280-281) describe an experiment in which various sprays were applied on 30th June against adults of *P. japonica* in a heavily-infested vineyard. The best protection was given by a spray containing 6 lb. lead arsenate, $\frac{1}{2}$ U.S. gal. white oil, 1 lb. bentonite and a spreader

in 100 U.S. gals. water, but one of 6 lb. lead arsenate in 100 U.S. gals. Bordeaux mixture (8 : 8 : 100) gave reasonable protection for most of the period during which feeding took place. The foliage on untreated vines was almost completely destroyed by 17th August.

Garman (pp. 268-278) summarises the results of investigations during the year on the effects of using suitable adhesives in sprays containing lead arsenate and a fungicide and reducing the number of sprays applied for the control of pests of apple [cf. 34 219-221]. Garman and J. F. Townsend (p. 280) give an account of an experiment to determine the season during which eggs of *Rhagoletis pomonella*, Walsh, are deposited on apples of the Cortland variety. The fruits were enclosed in bags about 1st July, the bags were removed at regular intervals, and the number of eggs and oviposition punctures counted a week later. It was found that oviposition began about mid-July or before and continued into September, but most of the eggs were laid during the first half of August ; protection should therefore be given to this variety from the first week in July until mid-September. In cage tests, dusts containing 1.5-5 per cent. DDT gave rapid mortality of the flies, but DDT sprays were relatively ineffective. DDT was not affected by an exposure to ultra-violet rays that was completely destructive to rotenone.

D. E. Greenwood (pp. 282-286) gives an account of observations on the damage caused to potatoes and tobacco by wireworms. One of the most important species is *Limonius agonus*, Say, which requires several years to complete its development and is most common in sandy loam soil under continuous cultivation. In general, wireworm damage to newly-set tobacco was negligible in 1943. Experience indicates that it is reduced when tobacco follows rye grown as a winter green manure crop, as the green manure provides attractive food for the short period during which tobacco is susceptible to attack. Potatoes, however, are unlikely to be protected in this way, as the main attack on them takes place later in the season, when the green manure has become less suitable as food. Tobacco was completely free from injury in a field in which rye had been ploughed under in spring and in which populations of *Hypnus* (*Cryptohypnus*) *abbreviatus*, Say, prior to planting ranged from 10 to 25 per sq. ft. Various observations showed that potatoes were more severely damaged by wireworms when they followed potatoes or grass than when they followed maize or tobacco, that damage to potatoes following various green manures increased when they were grown in the same plot in two successive years, and that damage to potatoes in individual plots increased after green manure crops had been grown in them probably because the increased soil fertility favoured the increase of wireworms. Larvae of *L. agonus* were found to occur within a foot of the surface of the soil throughout the summer ; the main feeding period extended from late July until early October, but is believed normally to be in August. If present in equal numbers, the larvae are less injurious than those of *Agriotes mancus*, Say, since they do not concentrate in the potato rows. They caused little damage to potatoes in a field that had been under hay and grass for the previous seven years, although they were numerous, but fed on the buried sod ; although *L. agonus* rarely oviposits in land covered by grass, a hay field may become so sparsely covered that it is as attractive for oviposition as a cultivated field.

Potatoes planted early in May were heavily infested by the European corn borer [*Pyrausta nubilalis*, Hb.], and N. Turner (pp. 287-288) records the effect on it of seven applications of dusts and sprays made between 2nd June and 12th July against the potato flea beetle [*Epitrix cucumeris*, Harr.]. It was intended to apply only five treatments in June, but the first was repeated owing to rain. The percentage reductions in number of entrances, as compared with untreated plants, were 92.5, 73.1 and 54.1 for dusts of derris and clay containing 2, 1 and 0.5 per cent. rotenone, 89.2, 79.2 and 73.1 for dusts of derris and pyrophyllite with the same rotenone contents, 90.1, 66.9 and

70.2 for dusts containing 50, 25 and 12.5 per cent. cryolite with clay, and 65.3, 53.3 and 17.8 for sprays containing 4, 2 and 1 lb. tetramethylthiuram disulphide per 50 U.S. gals. water. Control measures against *P. nubilalis* on potato are not needed each year, and the dusts applied against *E. cucumeris* should give control. As oviposition by the moth is almost over by 1st July, four applications at weekly intervals during June are recommended. Turner (pp. 288-292) also gives the results of two experiments with carriers for nicotine dusts. The first was on the influence of pyrophyllite and clay on the toxicity of nicotine bentonite (Black Leaf 155), containing 14 per cent. fixed nicotine, in dusts against *P. nubilalis* on maize, and it was found that about 5 per cent. nicotine with clay as the diluent was required to give the degree of control obtained from 3 per cent. nicotine with pyrophyllite. In the second experiment, Black Leaf 10 (nicotine absorbed by ground tobacco) was diluted with pyrophyllite or hydrated lime and applied against Aphids on young cabbage plants. Dusts containing 1, 2 and 4 per cent. nicotine gave 99, 99.2 and 99.4 per cent. reduction in the numbers of Aphids when the diluent was pyrophyllite, and only 93.5, 95.4 and 97.4 per cent. when it was lime. Details are given by Turner (pp. 292-297) of further studies on the relation between the number of insects on a plant and the damage caused by them [cf. 32 93], in which beans were artificially infested with different numbers of larvae of *Epilachna varivestis*, Muls. It was found that the damage to foliage increases as the logarithm of the number of larvae per plant, and that the effect of number of larvae on yield is also logarithmic.

Zappe (p. 298) reports that elm trees infected with Dutch elm disease (*Ceratostomella ulmi*) occur in most parts of the State west of the Connecticut river and in four places to the east of it. The results of surveys in 1942 and 1943 in 20 sample plots, each half a mile square, established in south-western Connecticut for the study of the spread of the disease in areas where no control measures are practised are given by P. P. Wallace and G. A. Zentmyer (pp. 299-300). There were 28 infected trees in these plots from which adults of *Scolytus multistriatus*, Marsh., emerged in the autumn of 1942 or the spring of 1943, and 92 newly-infected trees in 1943, representing 3.28 new infections for each tree from which emergence occurred. In a further study, the number of infected trees in areas surrounding 31 isolated and infected trees noted in 1937-40, most of which had been destroyed, was found to represent an average of 3.4 new infections for each isolated tree from which emergence was recorded. Zappe (pp. 301-302) reports that no galleries of *S. multistriatus* were found in 26 piles of elm logs placed near the north-eastern and eastern boundaries of Connecticut in surveys to determine its distribution there. *Hylastes* (*Hylurgopinus*) *rufipes*, Eichh., was found in only two and *Magdalis* sp. in three, but *Saperda* sp. was common.

J. V. Schaffner jr. (pp. 307-313) gives descriptions of all stages of *Gilpinia* (*Diprion*) *frutetorum*, F., which first attracted attention as a pest in Connecticut in 1940 [30 552]. *Pinus resinosa* and *P. sylvestris* are the only food-plants infested in the field in New England and *P. resinosa* the only one infested severely. In the laboratory, *P. nigra* and other hard pines were attacked. Infestation is most severe in plantations of *P. resinosa* that are over 24 years old, and none of the few natural stands of this pine or *P. sylvestris* in the United States has been attacked. The prepupae overwinter in cocoons and the adults continue to emerge from the latter half of May until the end of July, with a peak in the first fortnight of June. Adults of the new generation emerge from the second half of July until early September, but some individuals of this generation do not pupate until the following year. The eggs are deposited singly in slits in the needles and hatched in 6-15 days in the insectary. Larvae of the first generation are present on the trees from June until early August and those of the second from late July until late autumn. Old foliage is preferred for feeding, though current shoots may be attacked, especially by

second-generation larvae. Severe infestations have occurred only where the crown of the trees has closed. The cocoons are usually constructed among litter on the ground, but a few may be spun on twigs. Females appear to be rather more numerous than males. Parthenogenetic reproduction took place in the laboratory, but the sex of the offspring was not determined [cf. 23 596]. Two years' studies indicate that marked defoliation may occur when the average number of cocoons in spring is 3-6 per sq. ft. *G. frutetorum* has not caused complete defoliation in the United States, but it is increasing in some plantations of *P. resinosa*. At one place in Connecticut, the crowns of the trees in several plantations had been sufficiently thinned to permit the development of prolific undergrowth and single trees or groups of trees were dead or dying as a result of secondary infestation by *Pissodes approximatus*, Hopk., and *Ips* sp. The more important natural enemies of *G. frutetorum* in Connecticut are rodents and shrews, which destroy the cocoons, Pentatomids, which prey on the larvae during summer, and the cocoon parasite, *Dahlbominus* (*Microplectron*) *fuscipennis*, Zett., which was imported against *G. (D.) hercyniae*, Htg., on spruce. This parasite has been found in most of the plantations infested by *G. frutetorum* in the State since 1941 and parasitised 24.8, 25.4 and 23.6 per cent. of the cocoons in the severely infested plantations in 1941, 1942 and 1943, respectively. Its slow increase is largely attributed to the fact that mammals and ground insects destroy the host cocoons throughout the year.

A section on miscellaneous insects (pp. 313-319) includes a record by Garman of *Dasyneura mali*, Kieff., infesting apple orchards in 1943 for the first time in Connecticut, and notes on Lamellicorns by Johnson. The roots of sweet maize were damaged by larvae of *Anomala orientalis*, Waterh., in a field in which eggs had been deposited in thick grass in the previous season. Prolonged drought set in after 15th June and caused the injured plants to wilt rapidly. Soil from the golf course infested by *Aphonus castaneus*, Melsh. [cf. 32 96] was examined at intervals to study its seasonal development. Newly-developed adults were first found on 17th July and adults represented more than 66 per cent. of the population 12 days later. Adults were present in the soil until observations were discontinued on 21st September, but no eggs were found and no adults were observed in flight. Many larvae that had been killed by a fungus were found during the spring and summer. The larvae were scarce in part of a fairway that had been treated with lead arsenate at the rate of 10 lb. per 100 sq. ft. in the autumn of 1942; recovery of the grass was good, except on the areas that had dried out in the previous year. Adults of *Lachnosterna* (*Phyllophaga*) spp. were collected by hand or in light-traps during favourable weather conditions between the end of May and early July. Activity was great at temperatures above 70°F., but very few adults were trapped at temperatures below 60°F. Beech, elm, hazel, peach, climbing rose, oak and willow were severely defoliated in one place. *L. fraterna*, Harr., and *L. fusca*, Froel., were most numerous about the third week in May, *L. hirticula*, Knoch, which was the predominant species, appeared in the last week, *L. forsteri*, Burm., *L. anxia*, Lec., and *L. crenulata*, Froel., were most numerous during the first three weeks of June, *L. ilicis*, Knoch, *L. marginalis*, Lec., and *L. micans*, Knoch, appeared about mid-June and *L. tristis*, F., was most abundant in late June. Zappe records that an outbreak of *Rhynchaenus* (*Orchestes*) *rufipes*, Lec., which mines the leaves of willow but is usually scarce, was observed on *Salix pentandra* in August. Some leaves fell from the trees and all the others turned brown. They showed the characteristic feeding punctures of the adults, as well as the mines of the larvae. Eggs are laid in punctures in the leaves in late June or early July, the larvae pupate in their mines and the adults emerge in August. There is one generation a year, and the adults are said to hibernate in the soil under trees or under stones or loose bark. A spray of nicotine sulphate and soap applied in late June and again in mid-July is suggested for control.

OSBURN (M. R.). **DDT to control the Little Fire Ant.**—*J. econ. Ent.* **38** no. 2 pp. 167–168. Menasha, Wis., 1945.

Wasmannia auropunctata, Roger, which has a very irritating sting, nests in the soil or under debris and visits *Citrus* trees to obtain honeydew from mealybugs, Aphids and other insects. The ants are so numerous in some groves along the east coast of Florida that it is impossible to pick fruit, prune or spray without becoming covered with them. In experimental work carried out during the last few years, poisoned baits were not satisfactory, and sprays containing oil, pyrethrum, derris or dinitro-o-cyclohexylphenol destroyed many ants, but did not prevent heavy reinfestation within a week or two. In preliminary tests, DDT was found to be much more toxic and to provide more permanent control than any other material tested. Two series of experiments with it are being carried out in heavily infested grapefruit groves. In the first, one application of a spray of 8 or 16 oz. DDT in 1 U.S. gal. fuel oil, with 38 ml. glyceryl oleate as an emulsifier, diluted with water to 100 U.S. gals., applied thoroughly to the trunks and lower branches with a power sprayer, gave very good control for four months, with no indication that the trees were becoming reinfested at the end of this time, but 10, 5 or 1 per cent. DDT in pyrophyllite mixed with enough water to make a paste, applied with a brush in bands 8–10 inches wide round the trunks below the lowest branches, was less effective. There was no difference between the 5 and 10 per cent. bands, but the 1 per cent. mixture was the least effective of all treatments even when applied twice.

In the second series of experiments five sprays and a dust were compared. A spray of 4 oz. DDT, 2 U.S. quarts no. 2 fuel oil and 19 ml. glyceryl oleate per 100 U.S. gals. eliminated all ants in the trees at the time of application, and the trees were still practically uninfested after two months. Sprays containing the same amount of DDT with 6 U.S. quarts emulsive spray oil or with pyrophyllite as a suspension in water were less effective. In the last two sprays, 2 oz. DDT was inferior to 4 oz. A dust of 1 per cent. DDT in pyrophyllite was the least effective treatment.

Since it is impossible to prevent grasses and weeds from growing up through the trees, ants have undoubtedly gained access to banded trees in this way without crawling up the trunks, and many ants that were present when the bands were applied nested in protected positions on the trees to avoid crossing the bands. All treatments except the dust reduced the populations considerably, but sprays of DDT in fuel oil were the most effective. No injury was caused to grapefruit trees by spraying, dusting or banding. In both experiments it was observed that the DDT sprays killed the predacious Coccinellid, *Chilocorus stigma*, Say, as do the oil sprays applied against Coccids.

GYRISKO (G. G.), JODKA (J. F. T.) & RAWLINS (W. A.). **DDT to control Potato Insects.**—*J. econ. Ent.* **38** no. 2 pp. 169–173, 2 graphs, 2 refs. Menasha, Wis., 1945.

In tests of DDT dusts and sprays against insects infesting potato in New York, sprays of 1 and 1½ lb. DDT powder (10 per cent. actual DDT) per 100 U.S. gals. with a wetting agent and dusts of 0.3 and 0.5 per cent. DDT in talc with an insoluble copper fungicide were compared favourably with the standard spray of 6 or 8 lb. calcium arsenate per 100 U.S. gals. against *Leptinotarsa decemlineata*, Say, in Long Island, though laboratory tests indicated that DDT was less toxic to it than calcium arsenate as a stomach poison and less toxic than rotenone as a contact poison. The stronger dust appeared to be the most effective treatment. In only one test was more than one application required for control, and in this case (four applications of the two dusts at intervals of ten days) no pronounced residual effect was observed, possibly because of the low concentrations used. Dusts of 3, 5, 7 and 10 per cent.

DDT in pyrophyllite were as effective as the standard dust of 0.75 per cent. rotenone in sulphur against Aphids (*Macrosiphum solanifolii*, Ashm., and *Myzus persicae*, Sulz.) and flea-beetles (*Epitrix cucumeris*, Harr.) and highly effective against leafhoppers (*Empoasca fabae*, Harr.).

In western New York, potatoes were sprayed with Bordeaux mixture (10 : 10 : 100), alone or with the addition of 1 or 2 lb. DDT per 100 U.S. gals. or 0.25 per cent. Syntone (an extract containing 2.8 per cent. rotenone). The DDT reduced the populations of flea beetles and leafhoppers very markedly and retained its effectiveness for a long time, whereas the effect of the rotenone extract lasted less than two days. DDT was slower in toxic action than rotenone, but gave as good kill after 48 hours. Further tests with 0.6 and 0.8 lb. DDT per 100 U.S. gals. Bordeaux mixture gave similar results. Laboratory tests indicated compatibility of DDT with insoluble copper compounds, Bordeaux mixture and two organic fungicides, Fermate [ferric dimethyl dithiocarbamate] and Dithane [disodium ethylene bisdithiocarbamate], but preliminary tests with dusts showed a very significant reduction in toxicity resulting from the use of lime with DDT. DDT in concentrations as high as 10 per cent. in dusts and 5 lb. per 100 U.S. gals. in sprays did not damage potato foliage.

SMITH (F. F.) & GOODHUE (L. D.). **DDT Aerosols to control Onion Thrips and other Pests in Greenhouses.**—*J. econ. Ent.* **33** no. 2 pp. 173–179, 4 refs. Menasha, Wis., 1945.

DDT aerosols were tested against various insects in greenhouses in Maryland. The aerosols used in the authors' previous experiments [R.A.E., A **33** 43] were released through capillary tubes, but those containing DDT tended to clog the tubes, particularly if corrosion occurred in the containers, and oil-burner nozzles with strainers and having a capacity of 2 U.S. gals. per hour were therefore employed. They were preferably made of brass or stainless steel, which do not corrode. The dispensing unit was suspended by a heavy cord in the centre of the greenhouse, about 6 ft. above the floor or 18 ins. higher than the tops of the tallest plants, and the cord was twisted before the valve was opened, so that the container would rotate during the period of release. Glass slides coated with potassium palmitate put in different positions throughout the greenhouse showed that a better distribution of the droplets of insecticide was obtained when the air was circulated and that the droplets settled within an hour, so that the ventilators could be opened, if desirable, after that interval. The aerosols were released at any time except on sunny days when closing the ventilators would cause a rise in temperature detrimental to the plants.

Preliminary experiments with an aerosol of 3 per cent. DDT, 5 per cent. cyclohexanone, 5 per cent. lubricating oil (S.A.E. 10 or 30) and 87 per cent. dichlorodifluoromethane (Freon-12) indicated that about 1 gm. DDT per 1,000 cu. ft. should be used to give a high kill of *Myzus persicae*, Sulz., and adults of *Thrips tabaci*, Lind., and that equally good kills could be obtained with the same dosage of DDT applied in half the quantity of Freon. Omission of the oil rendered the aerosol less effective against both thrips and Aphids, reducing the maximum and average diameters of the droplets from 30 and 8.3 microns to 9.8 and 3.8 microns. In one large greenhouse, the number of droplets per sq. mm. ranged from 382 near the middle aisle and 10 ft. from the nearest dispenser to 230 in a corner 26 ft. from it, and droplet diameter ranged from 43.4 to 3.5 microns and averaged 11 microns. As it became evident that the cyclohexanone injured such plants as cucumber, acetone was substituted for half of it, and a mixture of 5 per cent. each of DDT, cyclohexanone, lubricating oil and acetone in 80 per cent. Freon was adopted as the standard for most of the aerosol treatments.

In some large greenhouses in which onions are grown from seedlings or bulbs to maturity in an extensive breeding programme, *T. tabaci* scarifies the foliage during the winter and spring and the flower heads as they develop in spring and summer. It was formerly controlled by frequent applications of sprays of nicotine sulphate or of tartar emetic and sugar, but they encouraged the development of *Botrytis* rot, so that there was often considerable loss of plants; fumigation with heavy dosages of calcium cyanide killed many exposed adults, but few of the nymphs in plant interstices. Treatment twice at an interval of 5-7 days in February or March with the standard aerosol at the rate of 1 gm. DDT per 1,000 cu. ft. killed adults and nymphs and resulted in the development of clean new growth; only an occasional living adult and no nymphs could be found for 4-6 weeks. Any adults that migrated to the treated plants were soon killed by the residues of DDT, and for more than a month no nymphs developed from any eggs they might have laid. In April the general release of aerosols had to be discontinued, as it killed the house-flies [*Musca domestica*, L.] confined as pollinators in cages of butter-muslin on the flower heads, and the residue affected those subsequently introduced. Paper bags inverted over the cages with the openings 6 ins. below them did not protect the flies. A heavy type of aerosol [cf. next abstract] consisting of DDT, cyclohexanone, lubricating oil, acetone and Freon-12 (5 : 10 : 5 : 30 : 50) was therefore applied directly to the onion foliage, particularly where the leaf blades joined the sheath. Adult thrips and most of the nymphs were paralysed within a few minutes and dropped to the ground, and flies caged on the seed heads were unaffected. One application so reduced the thrips (98.9 per cent. kill a week after treatment) that no further general treatment was needed during the two months before harvesting, individual plants being treated as they were found to be infested. Seed production of individual crosses was much heavier than in previous years, and only an occasional plant was lost from bulb rot.

A single treatment with the standard formula at the same rate of application eliminated *T. tabaci* from soy beans and killed 95 per cent. of adults and 74 per cent. of nymphs of the thrips in flowers of double stock (*Matthiola incana*); it also eliminated *Thrips nigropilosus*, Uzel, on plants and potted cuttings of chrysanthemum. Two treatments were used to kill *Hercinotrips femoralis*, Reut., on *Rudbeckia* sp. in the rosette stage, squill plants of all ages, peppers [*Capsicum*] and seedling cabbage, though one appeared to be sufficient, and four weekly applications killed adults of *Trialeurodes vaporariorum*, Westw., on tomato, egg-plant [*Solanum melongena*], potato and bean as they emerged and reduced the population to a few stragglers; the immature stages were unaffected. Colonies of *Myzus persicae* on the under surfaces of large leaves of cabbage, potato and *Solanum* sp. appeared to be unaffected for several days, and *Rhopalosiphum rufomaculatum*, Wils., on chrysanthemum was practically eliminated within two days of treatment. Exposed individuals of *Aphis maidis*, Fitch, on maize leaves were killed, but those in furled leaves were unaffected. Adults and nymphs of the cricket, *Grylodes sigillatus*, Wlk., and the cockroach, *Periplaneta americana*, L., were evidently affected by the DDT residue, as they were found dead or paralysed on the mornings following aerosol treatments, and adults of uncaged house-flies and the fungus gnat, *Sciara* (*Lycoria*) *inconstans*, Fitch, were quickly paralysed and killed. Adults of *Pseudococcus citri*, Risso, on squill were unaffected, but younger stages failed to become established and the colonies gradually dwindled, indicating that the active stages were affected by the residue. Woodlice (*Armadillidium*) were killed by DDT aerosols or their residues, but *Tetranychus bimaculatus*, Harvey, was unaffected.

The aerosols caused no injury to plants, except in certain cases to cucumber and tomato and soy-bean seedlings; experiments indicated that this injury was due to the cyclohexanone. Treatment of greenhouse plants with DDT

aerosols was found to be cheap and safe. They left no visible residue, but had both immediate and residual effect.

GOODHUE (L. D.), SMITH (F. F.) & DITMAN (L. P.). **DDT in Aerosol Form to control Insects on Vegetables.**—*J. econ. Ent.* **38** no. 2 pp. 179–182, 4 refs. Menasha, Wis., 1945.

Aerosols of pyrethrum extract and sesame oil dissolved in liquid dichlorodifluoromethane (Freon-12), which consist of small particles that remain suspended in the air for long periods without forming a perceptible deposit on surfaces, are suitable for the control of flying insects, but larger particles that settle faster and give a good deposit are required for the control of insects on plants. Many factors influence the properties of the aerosols [*cf. R.A.E.*, A **33** 99], and these must be considered before the method can be adapted to different uses. Any insecticide soluble in the available liquefied gas can be applied by this method. Liquids are best, but solids dissolved in high-boiling solvents can be used if the formation of crystals at the spraying orifice can be prevented [*loc. cit.*]. The most suitable liquefied gases are those in the low-pressure range (75–150 lb. per sq. in. at room temperature); they include dichlorodifluoromethane, chlorodifluoromethane (Freon-22), and propane, which are poor solvents for most insecticides, and methyl chloride and dimethyl ether, which are good ones. Methyl chloride, though too toxic to be used in the presence of man or animals in closed spaces, is an excellent propellant for aerosols to be used in the open on vegetable crops. Oils are important constituents of aerosols, influencing the effectiveness of the insecticide and the physical properties, including the particle size; some are good solvents for the insecticides and prevent clogging of the spraying orifice, and some act as auxiliary solvents when Freons are used. Another important constituent of an aerosol to be used for field crops is an organic solvent boiling between 68 and 212°F., substituted for some of the liquefied gas to increase the particle size of the aerosol, so that a deposit will be formed on the foliage; the inclusion of such a solvent is the most important difference between aerosols for field crops and those for space treatment. Acetone has been found to be the most satisfactory solvent. Any liquid that replaces some of the liquefied gas in the formula influences the particle size. The nonvolatile liquids form droplets that do not diminish in size after formation, but a volatile solvent such as acetone causes the droplets to become smaller as it evaporates and enables the proper settling rate and deposit to be obtained without the addition of enough oil to injure plants. A mixture containing it is termed a heavy aerosol in contrast to the light aerosol produced when the proportion of liquefied gas in the solution is large.

Brief accounts are given of the use of liquefied-gas aerosols in the greenhouse and in the field [*cf. preceding and following abstracts*]. The results of experiments in 1944 showed that DDT and some other insecticides, including nicotine, are very effective in aerosols and often better than when applied by other methods. Aerosol treatment gave better results than older methods on dense foliage, and would appear to be practical for growers of market-garden crops, since a rather large area can be treated easily and effectively with a light hand-drawn machine.

DITMAN (L. P.), SMITH (F. F.), GOODHUE (L. D.) & BRONSON (T. E.). **DDT Aerosols for Pea Aphid Control.**—*J. econ. Ent.* **38** no. 2 pp. 183–188, 1 fig., 10 refs. Menasha, Wis., 1945.

An account is given of experiments in Maryland in which aerosols containing DDT, nicotine or derris resins were applied against *Macrosiphum onobrychidis*,

Boy. (*pisi*, Kalt.) on lucerne and peas from nozzles arranged in pairs along a boom mounted on bicycle wheels and connected with an aerosol dispenser by copper tubing. The boom was adjustable to crops 6-18 ins. high. The machine was drawn by hand at $2\frac{1}{2}$ -5 miles per hour, and applications were made both with and without a 15-ft. apron attached to the back of it. Except where otherwise stated, the velocity of the wind was 5 miles per hour or less. Freon-12 (dichlorodifluoromethane) was the propellant gas for nicotine and methyl chloride for the other insecticides, and particle size was controlled by the addition of mineral oil and acetone [*cf.* preceding abstract].

In tests on lucerne in April and May at 64-79°F. and wind velocities of less than 7 m.p.h., aerosols containing 10 per cent. DDT and lubricating oil with 10 per cent. acetone and 20 per cent. cyclohexanone or orthodichlorobenzene or 40 per cent. trichlorethylene usually gave at least 90 per cent. reduction in Aphids, and one of 5 per cent. DDT and lubricating oil, 10 per cent. cyclohexanone and 30 per cent. acetone was equally effective except in a test in which one of the nozzles was clogged. An aerosol containing 10 per cent. nicotine, acetone and lubricating oil and 20 per cent. cyclohexanone gave 67-75 per cent. reduction after 2-3 days, and mixtures of 5 and 10 per cent. derris resins with acetone, lubricating oil and cyclohexanone gave 21-55 per cent. The machine was drawn at 5 m.p.h.

On peas in May, at 84°F., the aerosol containing 5 per cent. derris resins gave only 81 per cent. reduction in Aphids, whereas a spray of $2\frac{1}{2}$ lb. ground derris (6.3 per cent. rotenone) and $\frac{1}{4}$ lb. sodium lauryl sulphate per 100 U.S. gals. water gave 95 per cent., the 5 and 10 per cent. DDT aerosols with cyclohexanone, lubricating oil and acetone 91-95 per cent. and a 10 per cent. nicotine aerosol with 20 per cent. lubricating oil and acetone 87 per cent. The speed of application, which varied from $2\frac{1}{2}$ -5 m.p.h., and the presence or absence of the apron had no effect on the toxicity of the DDT aerosols. In a test at 74°F., the 5 per cent. DDT aerosol and aerosols containing 10 per cent. DDT in various combinations of the solvents gave 96 and 97-99 per cent. reduction in Aphids when applied at 5 m.p.h. with an apron, whereas a 10 per cent. nicotine aerosol gave only 84 per cent.; DDT aerosols containing 20 per cent. orthodichlorobenzene caused moderate to severe injury to the plants and the nicotine aerosol slight injury. In a test in June at 80°F., of aerosols containing varying proportions of DDT, oil, cyclohexanone and acetone applied without an apron at 5 m.p.h., the aerosols with higher proportions of acetone were slightly the more effective, and the need for either oil or cyclohexanone was not demonstrated. An aerosol containing only 2.5 per cent. DDT gave 75 per cent. reduction of Aphids. This aerosol gave 85 per cent. reduction in a subsequent test at 70°F., when the machine was drawn at the same speed and had no apron, though the wind velocity was 10-20 m.p.h., and reducing the quantity of DDT to 1 per cent. and reducing the amount of 2.5 per cent. DDT aerosol applied by closing half the nozzles decreased the reduction of aphids little (to 77 and 84 per cent., respectively). In a test on 1st July at 75°F., the 5 per cent. DDT aerosol gave a much more rapid reduction in Aphids than a spray of 8 lb. DDT (10 per cent.) and 2 oz. sodium lauryl sulphate per 100 U.S. gals. water, and the latter was somewhat more effective than a spray of 6 lb. derris powder (2.5 per cent. rotenone) and 4 oz. sodium lauryl sulphate per 100 U.S. gals.

The optimum concentration of DDT in heavy aerosols against *M. onobrychis* appeared to be 5 per cent. Some of them caused slight injury to pea plants, owing to the use of orthodichlorobenzene or of excessive amounts of oil or cyclohexanone, but this did not appear to reduce the yield. Nicotine aerosols injured both lucerne and pea plants. The cost of DDT aerosol treatment compared favourably with that of spraying or dusting with derris, and the equipment required was simple, light and relatively inexpensive.

SMITH (F. F.), DITMAN (L. P.) & GOODHUE (L. D.). **Experiments with Aerosols against some Pests of Truck Crops.**—*J. econ. Ent.* **33** no. 2 pp. 189–196, 2 refs. Menasha, Wis., 1945.

Aerosols containing DDT were tested against pests of market garden crops in Maryland and Maine in 1944 and were sometimes compared with aerosols containing derris extractives or nicotine. The aerosols were applied with apparatus similar to that described in the preceding paper, and Freon-12 [dichlorodifluoromethane] was the propellant gas for those containing nicotine, and methyl chloride for the others. Details are given of the formulae and supplementary agents used; no conclusions are drawn as to the effect of varying the proportions of the latter, but the heavy DDT aerosols were usually more effective than the light ones.

When applied on 6th June at 3½ miles per hour without an apron, a heavy aerosol containing 5 per cent. DDT and a light one containing 10 per cent. were less effective than a heavy one containing 10 per cent. against *Thrips tabaci*, Lind., on onions, but there was little difference between treatments after a second application on 21st June. Counts on 8th July showed a greater reduction of nymphs than of adults on the treated plots, indicating that breeding was reduced by all treatments and that adults were migrating into the treated plots from untreated ones. The treatments did not increase the yield of bulbs, apparently because the thrips population became large too late in the season to affect it. There was no significant difference in yield of heavily infested onions from one application, two or three fortnightly applications or six weekly applications of another heavy 5 per cent. DDT aerosol or six weekly applications of a spray of 2 lb. tartar emetic and 4 lb. white sugar per 100 U.S. gals. water in June–July. All treatments increased the yield as compared with untreated plots, but only two and three applications of the aerosol and the tartar emetic spray gave significant increases. Two or more applications of the aerosol completely protected the foliage from thrips injury.

In August, flea-beetles (*Epitrix cucumeris*, Harr.) on potato were affected by light and heavy aerosols containing 5 or 10 per cent. DDT almost immediately and were dead when examined 24 hours later; the inclusion of 5 per cent. derris resins reduced the efficiency of the 5 per cent. DDT aerosol. A 5 per cent. nicotine aerosol stupefied the beetles but allowed many to recover later. The DDT aerosols had a similar effect on *Lygus oblineatus*, Say (*pratensis*, auct.) on potato, but nicotine was less effective. Adults of *Philaenus leucophthalmus*, L., on peas were affected by aerosols containing as little as 1 per cent. DDT, and none survived on plants treated with those containing 10 per cent. Aerosols of 5 and 10 per cent. DDT applied with an apron gave almost complete control of *Macrosteles divisus*, Uhl., on lettuce. In tests against *Loxostege similalis*, Gn., on half grown spinach 5 per cent. aerosols of DDT and derris-resins gave 94 and 17 per cent. control, respectively, and a pyrethrum dust (0.2 per cent. pyrethrins) gave 54 per cent.; the 10 per cent. DDT aerosol was tested on mature spinach plants and gave 92 per cent. control. Aerosols containing 5 and 10 per cent. DDT caused rapid knock-down and high kill of *Gargaphia solani*, Heid., on egg-plant [*Solanum melongena*], whereas 5 per cent. nicotine caused rapid stupefaction but no kill, and 5 per cent. derris resins had no effect. Some eggs hatched later on the DDT plots, but a second treatment destroyed the nymphs, and the treated plants developed clean new foliage and fruited more abundantly than untreated ones. Only a few adults migrated into the treated area during the six weeks after treatment. No difference in effectiveness between 10 per cent. DDT aerosols with large and small particles could be detected in this test.

In tests against *Aphis rhamni*, Boy. (*abbreviata*, Patch), *Macrosiphum solanifolii*, Ashm., and *Myzus persicae*, Sulz., on potato, aerosols containing 5 and 10 per cent. DDT gave the best control, particularly when an apron was

used. Light aerosols were less effective than heavy ones, indicating that the latter penetrated among the foliage and left a more toxic deposit. A combination of derris resins and DDT appeared to be less effective, and nicotine stupefied the Aphids, but did not always kill them. Adults of the Japanese beetle [*Popillia japonica*, Newm.] on soy beans were all killed by aerosols containing 5 or 10 per cent. DDT, a dust of 5 per cent. DDT in pyrophyllite, or a spray emulsion containing DDT, xylene, Triton X-100 (an aralkyl polyether alcohol) (1 : 3 : 1) diluted with water to give a spray containing 0.4 lb. DDT per 100 U.S. gals.

A list is given of other insect pests that were observed on plants treated with DDT aerosols and were killed by them. The only ones that were resistant were the squash bug [*Anasa tristis*, Deg.], which was susceptible only in the early nymphal stage, the Mexican bean beetle [*Epilachna varivestis*, Muls.], adults and larvae of which were knocked down, but recovered unless in the hot sun, and the harlequin cabbage bug [*Murgantia histrionica*, Hahn]. As regards predacious insects, it appeared that the DDT aerosols killed all Carabid beetles in 24 hours, but had only a temporary effect at most on field populations of Coccinellids, Syrphids and Chrysopids. No plant injury occurred except on lima beans and snap beans treated with DDT aerosols containing high proportions of cyclohexanone.

Poos (F. W.). **DDT to control Corn Flea Beetle on Sweet Corn and Potato Leafhopper on Alfalfa and Peanuts.**—*J. econ. Ent.* 38 no. 2 pp. 197-199. Menasha, Wis., 1945.

In small-scale field tests carried out in Maryland in 1944 with DDT against *Chaetocnema pulicaria*, Melsh., which frequently destroys sweet maize in the seedling stage in gardens and is a vector of bacterial wilt [*Aplanobacter stewartii*] of sweet maize, an aqueous spray containing 252 gms. 10 per cent. DDT in pyrophyllite (0.66 per cent. actual DDT) and 1½ teaspoonsful of a proprietary spreader (sodium oleyl sulphate with a synthetic resinous adhesive) per U.S. gal. was applied five times between 13th and 29th May to three varieties of maize, and counts of beetles were made on various dates between 18th May and 9th June. The largest and smallest numbers found at any count on any of the varieties were 3 and 1 per 100 treated plants and 151 and 19 per 100 untreated ones. Treated plants were larger and more numerous than untreated ones, and the yield of the only variety for which it was ascertained was increased by 17.7 per cent.

A third cutting of lucerne in Maryland, which developed more slowly than usual owing to dry conditions and was infested with *Empoasca fabae*, Harr., was treated with the DDT spray, a dust of 2 per cent. DDT in pyrophyllite and a dust of pyrethrum in sulphur (0.1 per cent. pyrethrins) on 26th July and 4th August, at the rate of 27 U.S. gals. or 25 lb. per acre per application. Population counts showed good control of the leafhoppers with all treatments, but no nymphs appeared during August where DDT was applied, whereas they began to develop within a comparatively short time after pyrethrum was used. The yields of hay were 10.5, 12.2 and 7.1 per cent. greater on plots sprayed and dusted with DDT and dusted with pyrethrum, respectively, than on untreated plots, and it was of better quality. On ground-nuts in Virginia, a 2 per cent. dust of DDT in pyrophyllite, applied at the rate of about 20 lb. per acre on 20th July and 5th August, gave better control of *E. fabae* than sulphur dust applied on 6th and 20th July and 5th and 17th August and almost completely prevented the subsequent development of nymphs.

The DDT caused no injury to maize, lucerne or ground-nuts.

LANGFORD (G. S.), MUMA (M. H.) & CORY (E. N.). **DDT as an automatic Killing Agent in Japanese Beetle Traps.**—*J. econ. Ent.* **38** no. 2 pp. 199–201, 3 figs. Menasha, Wis., 1945.

Since 1938, from 50,000 to 100,000 traps for the Japanese beetle [*Popillia japonica*, Newm.] have been used each year in Maryland. To eliminate the need for periodical removal of the beetles from the containers, traps were designed in which the beetles are attracted by a bait in the baffles and after striking these fall through a steep-sided funnel on to a surface coated with insecticide and then fall free. The only insecticide that proved very effective was DDT, which was first tested in 1944. It was used either in a liquid medium in a small tin or bottle with a wick or in solid media in small cups or open salve boxes. The containers were hung about $\frac{3}{4}$ inch below the funnel opening, and killing surfaces 1–2 ins. in diameter were tested. The liquid medium, which consisted of equal parts of light white mineral oil (Saybolt viscosity 125–135), deodorised kerosene (Deobase oil) and a saturated solution of DDT in xylene gave an average of over 98 per cent. mortality in all the containers tested if the wick was arranged to provide a surface of about an inch in diameter, and most of the solid mixtures of pure DDT or DDT in pyrophyllite (1 : 4) with palmitic acid, lard, vaseline, axle grease and bearing grease were effective when compounded to a consistency that would support the weight of a beetle; one of the cheapest and most effective (about 99 per cent. mortality) was a mixture of pure DDT with axle grease (1 : 3) used in a salve tin with an exposed surface 1–1 $\frac{1}{4}$ ins. in diameter.

LANGFORD (G. S.) & CORY (E. N.). **DDT to control Japanese Beetles on Fruit.**—*J. econ. Ent.* **38** no. 2 pp. 202–204. Menasha, Wis., 1945.

An account is given of experiments carried out in Maryland throughout the summer of 1944 in which DDT was tested in emulsions, suspensions and dusts for the protection of the fruit and foliage of peach, apple, plum, cherry and grape-vine against the Japanese beetle [*Popillia japonica*, Newm.]. The stock for the emulsions consisted of a 20 per cent. solution of DDT in xylene or ethylene dichloride to which 20 per cent. Triton N.E. 100 was added, 20 per cent. DDT in pyrophyllite was used for the suspensions, and the dusts contained 2.5, 5 and 10 per cent. DDT in pyrophyllite. Preliminary work indicated that the xylene emulsion injures foliage when used in combination with Bordeaux mixture or applied to foliage coated with sulphur, and therefore it was not used in any of the large-scale tests; the water suspension appeared to be compatible with sulphur, Bordeaux mixture and lime-sulphur and the ethylene-dichloride emulsion with Bordeaux mixture.

Sprays containing 4 oz. actual DDT per 100 U.S. gals. in emulsions or suspensions gave complete kill of beetles that were exposed to direct wetting for 30 seconds in a wire cage and then dried on blotting paper and kept in clean cages, and in most tests in which beetles were collected from sprayed vines and caged immediately after spraying, though up to 10 per cent. recovered in some cases. In field spraying, however, large numbers of beetles were disturbed and flew away to avoid the spray, and the mortality among such beetles was not recorded. Thorough treatment with a 2.5 per cent. dust killed all beetles. Most of the beetles sprayed or dusted with DDT showed definite reactions within five minutes and were dead within 24 hours.

Dried residues of DDT on foliage were decidedly toxic to a large proportion of the beetles that touched them. When leaves from apple and pear trees and grape-vines were sprayed with mixtures containing 1 lb. actual DDT per 100 U.S. gals. spray, beetles put on them for five minutes reacted more quickly than those exposed for only 30 seconds, but the shorter exposure was sufficient to kill them. When the sprayed leaves were exposed to weathering for 1–24 days

before beetles were put on them, a water suspension applied as a coarse spray without a wetting agent gave the most efficient and lasting results, though its full effect did not usually last for more than a few days; the ethylene-dichloride emulsion was much less effective, but more desirable on ripening fruit as it leaves no obvious residue. Preliminary tests in which beetles were exposed to residues left by the evaporation of equal volumes of spray mixture from the emulsion and the water suspension showed that the difference in effectiveness was not entirely due to run-off, the reaction to the water suspension being the more rapid.

In the field, the addition of resin-residue emulsion as an adhesive to the emulsion or suspension, or of sodium lauryl sulphate as a wetting agent to the suspension neither improved the kill nor prolonged the residual action. Fruit and foliage coated with spray residues or dusts of DDT repel the beetles, but no tests were made to compare the lasting qualities of dusts and sprays. Excellent protection was obtained for periods of 7-14 days, and in a few instances it lasted for longer. General observations indicated that such factors as food-plant preference, rainfall, abundance of beetles and plant growth had an important influence on repellence; in the case of grapes and fast-growing nursery stock such as plum, cherry and apples, beetles sometimes returned and destroyed the new growth without feeding on sprayed foliage. Grape foliage was protected for 11-20 days and early-ripening peaches and plums by treatment 8-10 and 15 days, respectively, before harvest. In four heavily infested apple orchards, one application largely destroyed the swarms of beetles and protected the ripening fruit and foliage for the rest of the season.

WHEELER (E. H.). **DDT to control *Glossonotus crataegi*.**—*J. econ. Ent.* **33** no. 2 p. 274, 1 ref. Menasha, Wis., 1945.

Infestations of quince by the Membracid, *Glossonotus crataegi*, Fitch, are localised in western New York, but are severe enough to weaken small branches and twigs. The fruits are not attacked, but become covered with excrement and blackened by mould growth. In 1944, sprays of 1 lb. DDT per 100 U.S. gals., applied to quince for the control of the oriental fruit moth [*Cydia molesta*, Busck], caused the complete disappearance of nymphs of this treehopper, and sprays in which a water-dispersible powder containing DDT was used at various concentrations were therefore tested against it. They were applied to heavily infested quince trees on 23rd July, when 95 per cent. of the treehoppers were in the adult stage, and a cloth was spread immediately under one half of one tree in each treatment. One day after treatment with sprays containing 2, 4 and 8 oz. DDT per 100 U.S. gals., there were 1,666, 1,201 and 1,359 dead or inactive treehoppers on the cloths and 48, 46 and 28 living ones on the trees; there were no additional treehoppers on the cloths after 10 and 20 days. Some of the treehoppers found under the trees treated with two weaker sprays were not dead, but it is unlikely that they could have returned to the trees. Sprays containing 12 and 16 oz. DDT per 100 U.S. gals. resulted in 2,067 and 1,618 dead treehoppers on the cloths and 13 and 12 living ones on the trees after one day, 102 and 142 dead ones on the cloths after ten days and none and 20 after 20 days. The treehoppers present on the trees probably represented a reinfestation from adjacent trees, since they were found largely on the side next to these, and it is concluded that the knockdown of treehoppers was complete with all concentrations. The differences in the extent of reinfestation and the kill obtained during ten and 20 days after treatment show the residual effect of the heavier concentrations of DDT. From these results it is considered to be possible to eliminate *G. crataegi* from isolated plantings of quince early in the season; where reinfestation by adults may occur, additional treatments should be effective.

IVY (E. E.) & EWING (K. P.). **DDT to control the Cotton Leafworm.**—*J. econ. Ent.* **38** no. 2 p. 276, 2 refs. Menasha, Wis., 1945.

Tests carried out in Texas in 1944 confirmed the relative ineffectiveness of DDT for the control of *Alabama argillacea*, Hb., on cotton [cf. R.A.E., A **32** 378]. The following is based on the authors' summary. In field-cage tests, a dust of 2 per cent. DDT in pyrophyllite was only about one-third as effective against the larvae as calcium arsenate alone or with sulphur (1 : 1). The medial lethal dose of DDT in a water suspension applied to the dorsum was 61.5 mg. per gm. body weight, 206 times as great as that for larvae of *Heliothis armigera*, Hb. In field-plot experiments with dusts containing 1, 2, 4 and 8 per cent. DDT in pyrophyllite, applied on 2nd, 7th and 9th August at the rate of 16 lb. per acre per application, it was necessary to dust the plots with an arsenical after the third application to prevent defoliation. In other experiments, 4 per cent. DDT in pyrophyllite, applied at the same rate by ground machines and by aeroplane, failed to control the larvae. Tests to compare the residual effect of sprays and dusts containing DDT showed reductions in the numbers of larvae of 74.4 and 61.6 per cent., respectively, after six applications at 0.64 lb. DDT per acre, but neither treatment prevented almost complete defoliation of the plants.

THOMPSON (B. G.). **DDT to control *Psallus ancorifer* in Onions.**—*J. econ. Ent.* **38** no. 2 p. 277. Menasha, Wis., 1945.

Psallus ancorifer, Fieb., destroys the flowers of onions and is a serious pest of those grown for seed in Oregon. Losses vary from 5 to 50 per cent., depending on the size and position of the field, small plantings suffering most loss because the margins of the fields are most heavily damaged.

When Gesarol A-3 dust [3 per cent. DDT] was applied to a plot of seed onions infested with 25-75 Capsids per head under very windy conditions, so that coverage was apparently poor, no live bugs were present 48 hours after dusting, though there were dead ones deep in the onion blossoms. A full seed crop was obtained from the dusted plot, but the remainder of the field suffered 50 per cent. loss due to this Capsid.

COX (J. A.). **DDT for the Control of Grape Leafhoppers.**—*J. econ. Ent.* **38** no. 2 pp. 278-279, 2 refs. Menasha, Wis., 1945.

In 1944, Gesarol AK-20 (20 per cent. DDT), nicotine sulphate and Lethane B-72 (13.5 per cent. β - β -dithiocyanodiethylether) were tested in sprays against grape leafhoppers (*Erythroneura* spp.) in three commercial vineyards in Pennsylvania. All concentrations of spray ingredients are per 100 U.S. gals. water or Bordeaux mixture (4 : 4 : 100). In one vineyard, some of the vines were sprayed with 2.4 lb. Gesarol AK-20 and 3 U.S. quarts miscible oil in Bordeaux mixture on 8th June, before they bloomed, and all were sprayed with $\frac{3}{4}$ U.S. pint nicotine sulphate, 3 lb. lead arsenate and 3 U.S. quarts oil in Bordeaux mixture on 23rd June and 5th July. The vines sprayed with Gesarol had only one leafhopper per 10 leaves on 24th July and 67 on 5th September, and the others had 587 and 1,504, respectively.

In a second vineyard, vines sprayed with 3 lb. lead arsenate and 3 U.S. quarts miscible oil in Bordeaux mixture, applied on 23rd June and 3rd July, after flowering, had 870 leafhoppers per 10 leaves on 5th July. The addition to both these sprays of 0.5 U.S. pint nicotine sulphate or 1.9-3.8 lb. Lethane B-72, reduced the numbers to 4 and 6-2 on 5th July, but they had increased to 224 and 655-464 by 19th July and to 898 and 1,968-1,744 by 5th September, whereas the addition of 1.6 lb. Gesarol AK-20 to the spray applied on 23rd June reduced the numbers to 2 on 5th July, and they had increased to only 3 on 19th July and 98 on 5th September.

A third vineyard, which had previously been sprayed with nicotine sulphate, received a mid-season spray of 3 lb. Gesarol AK-20, 1 U.S. pint nicotine sulphate, or 3 lb. Lethane B-72, each with 2 U.S. quarts miscible oil in water on 18th July, or of 2 lb. Gesarol with 3 U.S. quarts miscible oil on 11th August. The numbers of leafhoppers per ten leaves on 24th July for the first three and no treatment were, respectively, 3, 20, 71 and 383, and those for the four sprays and no treatment were 11, 287, 396, 25 and 957 on 22nd August, and 14, 920, 888, 5 and 1,296 on 5th September.

It is concluded that one spray of DDT will give satisfactory control of *Erythroneura*, that it is toxic to both adults and nymphs, and that spraying is more satisfactory early in the season than in mid-season, as it reduces leaf-hopper damage to a minimum. By early September, there was considerable damage to plots treated with nicotine sulphate and Lethane B-72, and some on the outside rows of those treated with DDT. Neither Lethane B-72 nor Gesarol AK-20 injured the foliage or fruit.

HARMAN (S. W.). **DDT in the Codling Moth Program for western New York.**—*J. econ. Ent.* **38** no. 2 pp. 280–281. Menasha, Wis., 1945.

Sprays containing 4 lb. Gesarol AK-20 (0.8 lb. actual DDT) per 100 U.S. gals. with a spreader, and Gesarol A3 dust (3 per cent. DDT) were compared with the standard spray of 3 lb. lead arsenate, 3 lb. hydrated lime and $\frac{1}{2}$ lb. soy-bean flour per 100 U.S. gals. for the control of the codling moth [*Cydia pomonella*, L.] on apple in western New York in 1934. The full summer schedule comprised three cover sprays against the first generation, on 9th and 22nd June and 1st July, and two against the second, on 1st and 14th August. Fermate [ferric dimethyl-dithiocarbamate] was added to the first two DDT sprays and micronised sulphur to the first two lead-arsenate sprays for protection against apple scab. The numbers of entries and (in brackets) superficial injuries by the larvae per 100 fruits were 5.3 (14.8) and 4.7 (10.9) for five cover sprays of lead arsenate and DDT, respectively, and 40.5 (29) for DDT when the second and fifth sprays were omitted, indicating that the protective value of the DDT residue decreased rapidly after 10–14 days. They were 2.6 (8.5) and 9.7 (13.1) for five DDT sprays with 1 U.S. quart per 100 U.S. gals. spray in the last three, and 9.7 (13.1) when the last of these sprays was omitted, showing reduced protection when only one spray was applied against the second generation. They were 18.6 (14.5) for the dust, which was applied at 2–3 lb. per tree per application on 9th, 22nd and 30th June, 10th July and 1st and 13th August and 137.1 (22.1) for no treatment, the dust being thus much less effective than the spray. Dust applications were made on dry fruit during the heat of the day, and may be more effective if made in the late evening or if a little oil is incorporated in the dust. There was little or no visible residue on apples sprayed with DDT, whereas those treated with lead arsenate needed cleaning. The DDT sprays and dusts caused no increase in infestation by the red mite [*Paratetranychus pilosus*, C. & F.], which was very low, and no injury to the trees, except for some browning of the foliage in autumn [cf. *R.A.E.*, A **32** 386].

Winged migrant Aphids became as abundant on foliage sprayed with DDT as on that sprayed with lead arsenate, and production of young by them was apparently unaffected by the residue from the full schedule of sprays applied during the summer [cf. **33** 218], but trees that were sprayed with DDT on 7th October showed comparatively few migrant Aphids during the rest of the month, and no young were able to establish themselves, indicating again that the DDT residue either disappears or is converted to a compound less toxic to Aphids and *C. pomonella* after a few weeks.

It is concluded that DDT may prove a good substitute for lead arsenate under conditions in western New York.

WHEELER (E. H.). **DDT and Ryanex to control Oriental Fruit Moth on Quince.**

—*J. econ. Ent.* **38** no. 2 pp. 281–282, 4 refs. Menasha, Wis., 1945.

The results are given of field tests on the control of *Cydia* (*Grapholitha*) *molesta*, Busck, on quince, carried out in western New York in 1944, when the standard treatment of ten applications of 3 lb. lead arsenate per 100 U.S. gals., with the addition of 0.75 per cent. summer oil to the last six, at approximately ten-day intervals from 3rd June to 5th September, resulted in an average of 133.2 larvae per 100 fruits, with only 47 per cent. uninjured fruits. In the tests, the full schedule consisted of 11 sprays applied between 3rd June and 20th September, the first ten at intervals of ten days and the last after 19 days. Reduced DDT schedules consisted of seven sprays, all but the first two separated by 20 days, and four sprays applied on 8th June, 3rd July, 3rd August and 1st September. All the trees received a pre-blossom spray of sulphur against fungi, and Bordeaux mixture (3 : 8 : 100) was added to the other materials in the applications of 3rd and 13th June, 24th July and 1st September. All spray quantities are given per 100 U.S. gals.; the quantities of lead arsenate, summer oil, spreader and DDT were 3 lb., 2 U.S. quarts, 4 oz. and 1 lb., respectively.

The percentages of uninjured fruits and (in brackets) the numbers of larvae per 100 fruits were 85 (21.6) for 11 applications of lead arsenate with oil and spreader; 78 (40.2), 74 (41.4) and 91 (12.7) for three of lead arsenate with spreader followed by eight of 2 lb. Black Leaf 155 [14 per cent. fixed nicotine] with oil and spreader, 1 U.S. pint nicotine sulphate with oil and spreader, and 6 lb. Ryanex [an insecticide prepared from *Ryania speciosa* (R.A.E., A **34** 137)] with spreader, respectively; 99.5 (0.4), 98 (2.4) and 79 (30.2) for 11, seven and four applications of DDT; and 10 (367) for no treatment. It seems evident that the DDT residue is more lasting on quinces than on apples; [cf. preceding abstract], possibly owing to the dense pubescence covering the surface of the fruits throughout the season, since the DDT suspension spread readily over them and thoroughly soaked the hairy coating. The residues on the fruits on 17th October were 0.087, 0.047, 0.028 and 0.011 grains per lb. after 11, seven, four and one applications of DDT and 0.005 after none. The trees that received only one application were sprayed on 23rd June. DDT residues did not prevent oviposition, though they have been shown to be toxic to adults of *C. molesta* [R.A.E., A **32** 375]. Neither DDT nor Ryanex caused apparent injury to the plants, but DDT retarded ripening.

HAMBLETON (E. J.). **Experiments with DDT on Leaf-cutting Ants in Ecuador.**

—*J. econ. Ent.* **38** no. 2 p. 282. Menasha, Wis., 1945.

In preliminary experiments in Ecuador in July 1944, applications of a dust of 10 per cent. DDT in pyrophyllite to the entrances of some of the underground runways of *Atta cephalotes*, L., caused the ants to abandon these tunnels, though there was no indication of toxic action. On 2nd October, three nests, occupying an average of about 84 sq. yards of soil surface each, were treated with approximately 24 oz. of the dust, applied in the principal openings of the nest with a foot-pump, and two similar ones with rather more than 2 lb. per colony scattered by hand over the entire soil surface above the colony and particularly round each external opening to the nest and in positions where the ants would walk through it while entering or leaving the nest. Two weeks later, after several heavy rains, little of the dust mixture was visible where it had been broadcast. There was no indication that the DDT had poisoned the ants in any of the five colonies, all of which were heavily populated before and after it was applied. Where the mixture had been blown into the tunnels, the ants had removed from the nest all particles of leaf tissue bearing it. Excavation of the nests showed that numerous galleries and a small proportion of the fungus gardens had been abandoned, that new galleries had been

made and that activity within the nest seemed normal, though activity outside seemed to have been reduced temporarily. There had apparently been less disturbance within the nests over which the dust had been broadcast, little or none of the dust had reached the fungus gardens in any of the nests, indicating that dust mixtures of this kind cannot be effectively applied to large subterranean ant colonies with the available equipment.

LUGINBILL (P.) & BENTON (C.). **DDT to control the Chinch Bug.**—*J. econ. Ent.* **38** no. 2 p. 283, 1 fig. Menasha, Wis., 1945.

In tests of DDT as a barrier against nymphs of *Blissus leucopterus*, Say, migrating into fields of maize from adjacent wheat fields in Indiana in 1944, dusts of 5 or 10 per cent. DDT in pyrophyllite were scattered on strips about 3 ins. wide along the front and sides of plots containing about 18 plants at the rate of about 1 lb. per 5½ yards, and dusts containing 8 per cent. 4, 6-dinitro-o-cresol [numbered with OH as 1] along the backs. In one test, only one application was necessary; but in the other it had to be repeated because strong winds blew the mixture away and produced clear spaces in the line; no rain fell during the 10-day migration period. The two concentrations were equally effective in preventing damage to the maize, the majority of nymphs dying shortly after coming in contact with the material; some crossed the line and crawled on to the maize, but these died in a few days. There was no visible injury to the plants except for a slight curling of the bottom leaves. Unprotected maize was completely destroyed by the nymphs.

The results indicate that a dust of 5 per cent. DDT in pyrophyllite is as effective a barrier as an 8 per cent. dinitro-cresol dust, that lower concentrations might be effective and that a higher one is unnecessary.

On plots of oats, invaded by nymphs of *B. leucopterus* from adjacent barley plots, a light dusting with 5 per cent. DDT in pyrophyllite gave little control, but a considerably heavier application of 10 per cent. DDT dust, which completely covered the stems and the soil at the base of the plants, gave complete control with no damage to the plants. When infested plots of popcorn and sweet maize were dusted once with 1–5 per cent. DDT in pyrophyllite, all concentrations were equally effective, killing all nymphs with which they came in contact, and caused no damage to the plants. A few nymphs that were protected by tight leaf sheaths escaped, and after about two weeks, during which time some rain fell, the treated plants again became moderately infested.

In the laboratory, all nymphs exposed until thoroughly covered to dusts containing 1–5 per cent. DDT in pyrophyllite succumbed within 1–18 days, the majority dying within the first 7 days. All concentrations were about equally effective.

MORRISON (H. E.), MOTE (D. C.) & RASMUSSEN (W. B.). **DDT to control the Carrot Rust Fly.**—*J. econ. Ent.* **38** no. 2 p. 283. Menasha, Wis., 1945.

In field-plot tests carried out in Oregon in 1944 for the control of *Psila rosae*, F., which is now established in the north and north-west of the State, a 3 per cent. DDT dust applied to seedling carrots approximately half an inch high at the rate of 8 oz. per 30-ft. row reduced the percentage of infested carrots at harvest from 56 to 12 and was better than any other treatment. Many of the infested carrots on the treated plots were little damaged, whereas most of those in the control plots had to be discarded. In later tests, the use of the dust as a seed treatment at the rate of 2½ lb. per 180-ft. row reduced the percentage of infested carrots from 20 to 1.3. There was no evidence of plant injury from either treatment, although the rate of germination of the seed was slightly retarded.

REEHER (M. M.). **The Wheat Midge in the Pacific Northwest.**—*Circ. U.S. Dep. Agric.* no. 732, 8 pp., 4 refs. Washington, D.C., 1945.

Sitodiplosis mosellana, Géh., was first reported in the Pacific Northwest in 1904, when it damaged wheat in the Fraser River Valley of British Columbia. It apparently spread from there into north-western Washington, where it has caused injury to spring wheat since 1912. In 40 years, it has spread 180 miles southwards from the site of its introduction. Its progress has been slow because its food-plants, wheat, barley and rye, are not extensively grown in western Washington, and there are many natural barriers, but it is probable that it will eventually reach an important wheat-growing area in Oregon. An account is given of its bionomics, based mainly on investigations made in north-western Washington in the wheat-growing seasons of 1921–24, with some additional information obtained more recently. The larvae feed on the developing grains and three or four destroy one grain completely. Wheat is attacked in preference to barley or rye, and some varieties of barley are preferred to others. The larvae are full-fed in about a fortnight and then descend to the ground and make cocoons in the soil, where they pass the winter. The adults emerge in the latter part of June or early in July. Their abundance is closely related to rainfall during and shortly before the normal emergence period [*cf. R.A.E.*, A 27 66]. If the weather is dry at this time, the larva remains in the cocoon for another season. Eggs, which hatch in 5–7 days, are laid late in the afternoon and in the evening, singly or in clusters in grooves on the spikelets or under the glumes, during the period between the emergence of the ear from the sheath and the completion of blossoming. The males do not migrate far from the fields in which they emerge, but as the wheat matures the females seek other fields where the ears are younger. Autumn-sown wheat is usually little injured, as the grain is comparatively mature when the midges emerge. Sometimes all the ears and 52 per cent. of the kernels of spring-sown wheat were infested, but spring wheat sown by the first week in April usually escaped serious injury. On low, wet peat land both autumn- and spring-sown wheat were slow in maturing and were severely injured. Wheat fields in which the stubble is left unploughed are the main source of infestation. Stubble should be ploughed under before the midges emerge, and sowings of spring wheat should be as far as possible from the stubble of wheat that was infested the previous year and will remain unploughed because it was sown with grass and clover. The mite, *Atomus pilosus*, Banks, was found destroying many eggs in the low-lying fields, and the Platygasterid, *Inostemma horni*, Ashm., was observed ovipositing in eggs of the Cecidomyiid.

BARNES (H. F.). **Gall Midges of Economic Importance. Vol. I. Gall Midges of Root and Vegetable Crops.**— $8\frac{3}{4} \times 5\frac{1}{2}$ ins., 104 pp., 10 pls. (4 col.), 228 refs. London, Crosby Lockwood & Son, Ltd., 1946. Price 12s. 6d. **Vol. II. Gall Midges of Fodder Crops.**—160 pp., col. frontis., 3 pls., 305 refs. Price 15s.

These are the first two of a proposed series of volumes designed to correlate the information, at present scattered throughout the literature, on the Cecidomyiids of economic importance, with especial emphasis on their bionomics and control. In the first volume, the species that attack root and vegetable crops are dealt with in alphabetical order under the plants they attack. In the case of the more important species, the information includes synonymous and popular names in various languages, distribution, the ways in which infestation can be recognized, damage caused, biology, natural enemies and control. A list of the food-plants with the midges that infest them is included; it shows the parts of the plants attacked by the various species and thus serves as an additional aid in their identification.

The second volume deals in a similar manner with the species that infest fodder crops and is divided into three sections devoted to clovers and allied plants, grasses, and miscellaneous fodder plants, respectively.

KETTLEWELL (H. B. D.). **The Life-history of *Oria musculosa* in Britain (Lep. Agrotidae).**—*Entomologist* **78** no. 985 pp. 85–86. London, 1945.

From the distribution of larvae of *Oria musculosa*, Hb., within fields of spring-sown cereals near Salisbury in 1943, Edelsten concluded that the eggs from which they hatched had been laid on cereals grown in the fields in the preceding year [*R.A.E.*, A **33** 307]. The author believes that a cereal field is not the normal source of infestation, however, as eggs laid on cereals would have to be placed either on the stubble after harvest or on the straw of the growing plants. In the former case, they would be ploughed in and spend the winter under a considerable depth of earth, and any larvae that might hatch would not find cereals available next season if the usual crop rotation were being practised. In the latter case, the larvae would not hatch in the field unless the straw were turned into manure and thrown on the land. It is considered more probable that the eggs are laid and the larvae more usually feed on the grasses at the edges of the fields and that the habitat is extended and the species consequently increases when rotation of crops is abandoned. *Bromus erectus* is common round the fields, and the grass that is often infested in Russia and from which the larvae migrate to cereals is a species of *Bromus*. With reference to the suggestion that the eggs overwinter in straw stacks and the larvae migrate to cereals near them [*loc. cit.*], it is pointed out that the eggs can occur in straw only in years of late harvest when the adults emerge before the crop is cut. In 1939, the author failed to find any trace of infestation in sprouting cereals around four stacks.

CORBET (A. S.) & TAMS (W. H. T.). **Observations on Species of Lepidoptera infesting stored Products. XIII. The Identity of *Hyphantidium sericarium* A. W. Scott (Pyralidae).**—*Entomologist* **78** no. 985 p. 87. London, 1945.

The authors conclude that *Hyphantidium sericarium*, Scott, is a synonym of *Ephestia elutella*, Hb., and not, as they had supposed [*R.A.E.*, A **31** 310], an earlier name for *E. kuehniella*, Zell. The characters given in the original description of *H. sericarium* are insufficient for identification, and the type specimen appears to be lost, but the larvae were found in stored maize and were stated to produce large sheets of webbing. Sheet webbing is characteristic of *E. elutella* and not of *E. kuehniella*, and the former is commonly found in stored maize, which is rarely infested by the latter.

HINCKS (W. D.). **Nomenclature Notes on some parasitic Hymenoptera (Ichneumonidae and Eulophidae).**—*Entomologist* **78** no. 985 pp. 89–91, 7 refs. London, 1945.

In making corrections to his previous paper [*R.A.E.*, A **32** 325], the author points out that the type of *Porizon* is not *Ichneumon moderator*, L., which has been found to be a species of *Nemeritis* (*Phaedroctonus*), with *N. (P.) cremastoides*, Hlmg., as one of its synonyms, but *Ophion moderator*, F., which he considers of uncertain identity. *Porizon* should therefore be regarded as of doubtful status and not as an earlier name for *Thersilochus* [*loc. cit.*].

He also proposes *Dahlbominus*, n. n., for *Microplectron*, Dahlb. nec Streubel (Aves), type *Entedon fuscipennis*, Zett.

[KARPOVA (A. I.).] **Карпова (А. И.). Insects injurious to Alfalfa in the Hissar Range of Tadzhikistan.** [In Russian.]-Rev. Ent. URSS 28 no. 1-2 pp. 1-7, 17 refs. Moscow, 1945. (With a Summary in English.)

Insects much reduce the yields of lucerne hay and seed in Tadzhikistan, and a survey of the species concerned in non-irrigated fields was carried out in 1940 and 1941 in three districts in the central part of the southern slope of the Hissar mountains situated in the lower and upper belts of the forest zone and in the subalpine zone at altitudes of about 4,000, 6,000 and 10,000 ft., respectively. A list is given of upwards of 40 species found, with notes on the parts of the plant attacked by them. Those not previously recorded as pests of lucerne were, *Sitona fronto*, Faust, and *Silpha (Aclypea) turkestanica*, Ballion, of which adults and larvae, respectively, attacked the young seedlings, *Leptomias bimaculatus*, Faust, *Aristotelia subericinella*, H.-S., and *Plusia (Phytometra) circumflexa*, L., which fed on the leaves of older plants, two unidentified species of *Hypera*, which fed on the leaves and young inflorescences, two species of Tortricids, which attacked the seeds in the pods, and the Pentatomids, *Dolycoris penicillatus*, Horv., and *Codophila varia*, F., which caused rolling of the leaves and withering of the inflorescences.

The pests of greatest importance in reducing the seed crops were *Hypera (Phytonomus) variabilis*, Hbst., the larvae of which fed on the terminal leaves and inflorescences, the Capsid, *Adelphocoris lineolatus*, Goeze, which caused the inflorescences to dry up and the leaves to roll, and the Eurytomid, *Bruchophagus gibbus*, Boh., and weevils of the genus *Tychius*, chiefly *T. femoralis*, Bris., which destroyed the seeds. *B. gibbus* produced three generations a year in the lower forest belt, and only one in the subalpine zone. The species of *Tychius* had one generation a year and were abundant at the lower altitudes. The pests were few in numbers and species in the subalpine zone; *H. variabilis* did not occur there and the only species of *Tychius* was *T. femoralis*, but the unidentified species of *Hypera* caused a little damage. In the lower belt of the forest zone, *H. variabilis* attacked about 50 per cent. of the inflorescences in fields of the first mowing, and *B. gibbus*, *Tychius* spp., and the Tortricids injured about 50 per cent. of the seeds. An almost equal reduction in the seed crop of the second mowing resulted from damage to the inflorescences by *A. lineolatus* and to the seeds by *B. gibbus*. The pests were far less injurious in the upper belt of the forest zone, where only 5-6 per cent. of the buds and inflorescences were attacked by *Hypera* spp., and about 20 per cent. of the seeds by *B. gibbus* and *Tychius* spp. The lucerne grows well at this altitude; the quality of the seeds from the crop of the first mowing is as good as in the lower zone, and the total yield of hay is better.

A programme for control of the pests in which cultural measures are supplemented by the use of insecticides is outlined on the basis of the author's experience and the literature [cf. R.A.E., A 26 76; 27 108; 33 305, etc.]. In Tadzhikistan, lucerne of the first mowing should be the seed crop, as it is injured less than the second crop by *A. lineolatus* and *B. gibbus*.

[SEMENOV (A. E.).] **Семенов (А. Е.). Buprestid Beetles of the Genus *Capnodis* injurious to Orchards cultivated without Irrigation in Tadzhikistan.** [In Russian.]-Rev. Ent. URSS 28 no. 1-2 pp. 8-13, 2 figs., 4 refs. Moscow, 1945. (With a Summary in English.)

Peaches, plums and apricots are grown without irrigation in Tadzhikistan by grafting them on a local wild almond that is resistant to drought. The stems of the almonds are cut in autumn or early spring so that a tall stool is

left from which young shoots soon grow in profusion, and buds of the fruit trees are grafted on them. Serious damage in the non-irrigated orchards is caused by the Buprestids, *Capnodis carbonaria*, Klug, and *C. tenebricosa*, Ol. The adults are present from the beginning of April to the end of October and oviposit from early July to September, the eggs being laid in batches of 20-40 in cracks in the bark, usually at the root-collar. The larvae hatch in 12-15 days, penetrate under the bark and apparently feed on the cambium; as a rule, they injure the roots and the root-collar. The larval stage probably lasts 18 months. Both species were found to infest wild and cultivated almond, apple, peach, and allied trees and showed definite preference for almond, but the chief damage in the non-irrigated orchards is caused not by the larvae but by the adults. These occur during May in the crowns of the almond trees, feeding chiefly on the stalks of the leaves. With the onset of dry and hot weather at the beginning of June, they migrate to the suckers, which are sprouting at this time from the roots of the almonds, and feed on the leaves and juicy bark, thus killing the young plants. They also destroy the shoots that grow from the buds of the fruit trees after they have been grafted on the wild stock.

In experiments on control, the beetles were caged with branches of wild almond that had been dusted with calcium arsenate. All adults of *C. carbonaria* and 85 per cent. of those of *C. tenebricosa* were dead in five days, and there was no mortality in control cages during this period. In field tests in the second half of June, the beetles were confined in the crowns of wild or cultivated almond trees dusted with calcium arsenate, and the percentages dead in five days were 96 for *C. carbonaria* and 100 for *C. tenebricosa*. The almond leaves were not injured. The author therefore suggests that the shoots of the grafting stock should be dusted at intervals of 15 days during the period when the beetles feed on them. The dust should be applied at the rate of about 5 lb. per acre, and the tender shoots growing from the grafted buds of the fruit trees should be protected from it by a cover of paper or dense fabric.

MARTIN (H.) & WAIN (R. L.). **The qualitative Examination of insecticidal Properties. Progress Report, 1944.**—*Rep. agric. hort. Res. Sta. Bristol 1944* pp. 121-140, 1 fig. table, 7 refs. Bath [1945].

In this second progress report [*cf. R.A.E., A 33 197*], the authors describe further investigations on methods of evaluating insecticides and the results of their application. When larvae of *Mamestra brassicae*, L., were fed on sandwiches each containing 1 mg. or 0.2 mg. α -bis (parachlorophenyl)- $\beta\beta$ trichlorethane (DDT) [*cf. loc. cit.*], the mean lethal doses, adjusted to a body-weight of 0.3 gm., were 0.62 and 0.074 mg. DDT, respectively. In tests to determine whether this diversity in results was due to the ability of the insect to consume more than the toxic dose, owing to the slow action of the insecticide, the larvae were fed on larvae newly poisoned by DDT or unpoisoned larvae killed by crushing without rupture of the cuticle or on extracts of them. Tests with larvae killed after feeding on the related non-toxic compound α -bis (parachlorophenyl)- $\beta\beta$ dichlorethylene (DDX) were included to cover the possibility that DDT leaves a poisonous decomposition product in the dead larvae. It was found that larvae killed by DDT had much greater insecticidal properties than those killed after feeding on DDX, and that the other larvae and extracts of them were non-toxic; four out of six larvae fed on sandwiches containing extracts of DDT-poisoned larvae showed typical symptoms of poisoning in 90 hours after consuming an average of 0.0112 mg. DDT calculated on the amount taken by the extracted larvae. These results support the conclusion that the sandwich method gives an exaggerated estimate of the

lethal dose, the extent to which it exceeds the true one being dependent on the speed of action of the poison and the appetite of the individual larva.

An additional method of testing contact action [*cf. loc. cit.*] was developed in which test organisms were put in contact with a treated surface. A known amount of the toxicant, dissolved in a volatile solvent such as acetone or chloroform, was pipetted on to a filter paper, and the solvent was allowed to evaporate. The test organisms were then put on the paper in a petri dish. Plugs of cut potato were added for organisms such as woodlice that are susceptible to low humidity and appropriate food material for leaf-eating larvae. Moribund or dead individuals were removed to avoid cannibalism and the consequent possibility of stomach-poison action. Statistical analysis indicated that the method is satisfactory for detecting major differences in toxicity.

Tests have indicated that the only reaction that can render DDT chemically incompatible with other components of sprays is the elimination of hydrogen chloride to form the dichlorethylene derivative (DDX), and this reaction did not occur in deposits of DDT in containers filled with milk of lime, Bordeaux mixture or lime-sulphur and kept out of doors for several months. Moreover, treatment with lime-sulphur of filter papers impregnated with DDT did not reduce their toxicity to woodlice. Physical compatibility might be a problem if the added component were able to include the insecticide or absorb it strongly [*cf. R.A.E., B 33 77*], but the addition of petroleum oil to DDT or papers treated with it did not reduce its toxicity to woodlice.

Contact tests with DDT and analogues in which other halogens were substituted for the para-chlorine atoms showed a trend of insecticidal potency, which was greatest in the fluorine compound and least in the bromine and iodine analogues, and tests of these analogues as stomach poisons against *Mamestra brassicae*, L., *Pieris brassicae*, L., and *P. rapae*, L., showed a similar trend. The halogen-substituted analogues of DDX showed negligible toxicity in all tests except in the case of the fluorine analogue. Replacing the para-chlorine atoms of DDT by organic radicals reduced toxicity, owing to either solubility factors or the electronic effect of the group; the former seem to be the more important. Tests of the monochlor and asymmetrical ortho-para-dichlor derivatives as stomach and contact poisons showed that they have activities intermediate between those of DDT and the unsubstituted diphenyl trichlorethane. The ortho-para compound, which is present as a concomitant product in commercial DDT, cannot, therefore, be considered an inactive impurity. The differences in toxicity may again be ascribed to solubility factors if asymmetry affects the surface activity of the molecule and its adsorption at the sensitive interface. Certain compounds obtained by modification of the $-\text{CH.CCl}_3$ group of DDT were ineffective as stomach or contact poisons. Since the only toxic derivatives among the ones tested in these investigations are those from which it is possible to eliminate hydrogen chloride, it appears that the cause of toxicity is the ability of the compound to liberate this at the site of action within the organism, and it is concluded that DDT is insecticidal because it is able to penetrate and to concentrate at the site of action, has sufficient stability to reach it, and can release hydrogen chloride when adsorbed at the sensitive interface within the organism.

A sample of benzene hexachloride, consisting of an unknown mixture of stereoisomers [*cf. A 33 256*], was effective as both a contact poison and a stomach poison, though larvae of *M. brassicae* appeared to be less susceptible than other species. The interpretation of the results obtained is complicated by the ability of this substance to act as a fumigant. The addition of oil to papers impregnated with it reduced its toxicity to woodlice, possibly because of its low solubility in the oil and interference with volatilisation. It resembles rotenone in its specificity of action [*cf. A 33 197*], but the toxic symptoms it produces in susceptible organisms closely resemble those of DDT poisoning, and it is capable of hydrogen-chloride elimination.

In further tests, aromatic nitriles [cf. A 33 198] showed little promise as stomach poisons, but appeared to merit further investigation as contact poisons and fumigants, particularly in the case of the ortho- and para-substituted benzonitriles.

MILES (H. W.). **Experiments on the Control of Flea Beetles on Brassicae in the Western Province.**—*Rep. agric. hort. Res. Sta. Bristol 1944* pp. 145–149, 1 pl., 2 refs. Bath [1945].

The results are given of experiments carried out in Wiltshire, Herefordshire and Worcestershire in 1944 with dusts against flea-beetles [*Phyllotreta*] on crucifers. The dusts were DDT [3 per cent.], P.P.666 [which contains 0.26 per cent. of the γ isomer of benzene hexachloride (gammexane) (cf. R.A.E., A 33 256–257)], and basic slag, and they were applied on the day that the seedlings appeared in numbers. The flea-beetles were active and the weather was generally dry and sunny. Plots dusted with DDT and P.P.666 were green when little leaf tissue remained on untreated plots, though differences in the numbers of plants on the various plots were not great. The numbers of plants on dusted plots 1, 2–8 and 9–16 days after dusting, adjusted to an index figure of 100 for the numbers on control plots after these periods, were, respectively, 104, 83 and 189 for DDT, 112, 73 and 150 for P.P.666 and 113, 100 and 55 for basic slag. These figures indicate that the DDT and P.P.666 may have had some phytocidal action on the seedlings, but that this was subsequently more than compensated for by the protection from flea-beetle injury afforded during later stages of growth. Other estimates from some of the experiments showed that DDT and P.P.666 killed the beetles present when they were applied, increased the percentage of plants free from attack on the next day from 24 (in control plots) to 59 and 63, and reduced the number of leaves attacked per plant during the first week from 2 to 0.95 and 0.89. The need for a second dusting appeared to be local and seasonal, and it is concluded that one application of DDT or P.P.666 is sufficient, but that several applications of basic slag at short intervals would be required to obtain satisfactory establishment of the seedlings.

PAPERS NOTICED BY TITLE ONLY.

BODENHEIMER (F. S.). **Seven new Species of Coccidae from Anatolia** [including *Margarodes tritici* on wheat (*Triticum durum*)].—*Rev. Fac. Sci. Univ. Istanbul* (B) 6 fasc. 1–2 pp. 65–84, many figs., 1 ref. Istanbul, 1941. (With Summaries in Turkish and French.)

BRUES (C. T.). **Insect Dietary. An Account of the Food Habits of Insects.**— $8\frac{1}{2} \times 5\frac{1}{2}$ ins., xxvi+466 pp., 22 pls., 68 figs., many refs. Cambridge, Mass., Harvard Univ. Pr. London, G. Cumberlege, Oxford Univ. Pr., 1946. Price \$5.00 or 28s.

POWNING (R. F.). **The Analysis of D.D.T. and Pyrethrins in Kerosene-based Sprays** [containing both].—*J. Coun. sci. industr. Res. Aust.* 18 no. 2 pp. 121–123, 3 refs. Melbourne, 1945.